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With the compliments of

George W. Rafter. Commissioner

N. Y. State Water Storage Comm.

New York State
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REPORT

OF THE

NEW YORK STATE

Water Storage Commission

APPOINTED BY

GOVERNOR B. B. ODELL, JR.

APRIL 16, 1902.

UNDER AUTHORITY OF

Chapter 406 of the Laws of New York of 1902.

TRANSMITTED TO THE LEGISLATURE JANUARY 26, 1903.

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STATE OF NEW YORK.

No. 37.

IN SENATE,

JANUARY 26, 1903.

REPORT.

To the Honorable the Legislature of the State of New York:

In compliance with the requirements of chapter 406 of the Laws of 1902, we have the honor to submit herewith the report of the Water Storage Commission.

Very respectfully,

JOHN CUNNEEN,
Chairman.
EDWARD A. BOND,
CHARLES S. BOYD.
D. C. MIDDLETON.
OLIN H. LANDRETH.
JOHN L. KING.
ELNATHAN SWEET.
GEORGE W. RAFTER.
GEORGE R. FINCH.

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REPORT

OF THE

NEW YORK STATE

WATER STORAGE COMMISSION

PART I. Report of the Commission.

PART II. Reports of the Commissioners representing the four divisions of the State.

PART III. Appendices.

PART I.

REPORT OF THE COMMISSION.

Reasons which led to the appointment of the Commission:

The serious nature and extent of the floods in a large number of the streams throughout the State have long been a source of injury and danger to citizens. Progressive changes in forestry and cultivation, in hydrographic conditions, in the density of population and consequent increase in the value of lands subject to flooding, have tended to aggravate rather than ameliorate this injury and danger.

The failure to take proper corrective measures has been due in no sense to a want of interest, intelligence or energy on the part of the citizens of the State: Three obstacles have generally rendered individual and local remedies difficult and ineffective:

1. The complexity of the hydrographic problems usually involved in flood conditions require for their solution an amount of technical investigation that is generally of prohibitive cost to individuals and small municipalities.

2. The proper remedies, when ascertained, demand, in most cases, the acquiring of land, water rights and easements, which are beyond the powers of individuals or minor municipalities to secure.

3. The distribution of the burden of expense of improvements in a manner equitable and mutually satisfactory to the various

interests concerned, is practically impossible without official power of assessment.

With the evident desire to determine in general what measures or legislation were needed to overcome the obstacles and to secure to the people of the State proper and feasible means of flood prevention, the Legislature of the State of New York, in April, 1902, enacted the following law creating the Commission:

CHAP. 406.

AN ACT to provide for the appointment of a commission to investigate the causes of floods and overflows of rivers and water courses, and to make recommendations for preventing the same, and making an appropriation therefor.

Became a law, April 7, 1902, with the approval of the Governor. Passed, three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. The governor is authorized to appoint within thirty days after the passage of this act five citizens of the state, who, together with the superintendent of public works, the state engineer and surveyor, the commissioner of forest, fish and game, and the attorney-general shall constitute a commission to be known as the water storage commission.

§ 2. The water storage commissioners herein provided for shall before entering upon the discharge of their duties take and subscribe the constitutional oath of office and file the same in the office of the secretary of state. They shall receive no salary but shall be paid their actual and necessary expenses incurred in the performance of their duties. The office of such commission shall be at the capitol in the city of Albany. The said board may appoint a secretary who shall be paid a salary of not to exceed two thousand dollars per year. The attorney-general shall appoint one of his deputies to render such legal services as may be required, and the state engineer and surveyor shall designate an engineer and such other assistants as may be

required to make such surveys as may be found to be advisable. The compensation of the persons so appointed and designated shall be paid from the moneys herein appropriated.

§ 3. The commission when so appointed shall proceed at once to make such surveys and investigations as may be proper to determine the causes of the overflow of the various rivers and water courses of the state and to determine what, if anything, can be done to prevent such overflow.

§ 4. The commission shall report in writing to the legislature on or before March first, nineteen hundred and three, and file in the office of the state engineer and surveyor all maps, plans and surveys and transmit to the legislature with its report such recommendations as it may have to make, and from and after such date such commission shall cease to exist.

§ 5. The sum of five thousand dollars, or so much thereof as may be necessary, is hereby appropriated from any moneys in the treasury not otherwise appropriated, for the purposes of such commission.

§ 6. This act shall take effect immediately.

PERSONNEL AND ORGANIZATION.

The Commission as completed by the appointment of five citizens by the Governor on April seventeenth, comprised the following gentlemen:

John C. Davies, Attorney-General.

Edward A. Bond, State Engineer and Surveyor.

Charles S. Boyd, State Superintendent Public Works.

D. C. Middleton, State Commissioner Forest, Fish and Game.

Olin H. Landreth, Schenectady.

John L. King, Syracuse.

Elnathan Sweet, Albany.

George W. Rafter, Rochester.

George R. Finch, Glens Falls.

On April twenty-ninth the members of the Commission met in Albany and organized by the selection of Hon. John C. Davies, Attorney-General, as chairman, and at a meeting of the Commission held on May twelfth Mr. Harry Bates, of Rensselaer, was elected as secretary of the Commission.

Upon application to the State Superintendent of Public Buildings, an office on the fourth floor of the capitol building was assigned the Commission.

MEETINGS OF THE WHOLE COMMISSION.

The following is an outline of the meetings of the whole Commission which have been held, with a summary of the more important actions taken:

First meeting, held at the office of the State Engineer and Surveyor, Albany, April twenty-ninth. Meeting for organization and general discussion of the scope of the proposed work of the Commission. Hon. John C. Davies, Attorney-General, was elected permanent chairman, and a committee, comprising Commissioners King and Middleton, was appointed to consider and report on the matter of the selection of a secretary. Commissioner Rafter was requested to report at the next meeting as to the extension of the number of stream gauging stations in the State under the existing system of co-operation between the United States Geological Survey and the New York State Engineer and Surveyor.

Second meeting, Onondaga lake, May twelfth. A meeting held for general business and for the inspection of flood conditions in the vicinity of Syracuse.

The Commission elected as its secretary, after the report of the special committee appointed for the purpose of making a recom-

mendation, Mr. Harry Bates, of Rensselaer, at a salary of $1,500 per annum.

Commissioner Rafter submitted a report on the extension of stream gauging stations.

Commissioners Sweet and Bond were named as a committee to prepare a form of circular blank for the collection of information and statistics from different parts of the State concerning flood conditions and damages.

Commissioners Davies and Boyd were appointed an auditing committee to have charge of the finances of the Commission.

Commissioner Rafter submitted important legal questions pertaining to riparian rights, which were referred to Attorney-General Davies for an opinion.

The Commission made a tour of Onondaga lake and its outlet, and Oswego river as far as Phoenix, and on the day following the Commission inspected a proposed reservoir site on Onondaga creek near Tully.

Third meeting at the capitol, Albany, May twenty-ninth.

The form of information circular blank which was submitted was discussed and adopted, and the secretary instructed to distribute the blanks throughout the State to members of the Legislature and to supervisors and other officials in flooded districts.

In order to provide for systematic work, and the concentration of individual effort in definite localities, the Commission divided the State into four divisions, and assigned two members of the Commission to each division, an engineer being designated at the head of each. These divisions were as follows:

Division No. 1. To be known as the western district. Bounded easterly by a line between the watersheds of the several finger lakes and that of the Genesee river, the Chemung river and

the Susquehanna river, including all that section of the State west of the division line.

Division No. 2. To be known as the central division, embracing Oswego river, including the watershed of the finger lakes and the Seneca and Oneida rivers and the watersheds of the Susquehanna and Delaware rivers and their tributaries in the State.

Division No. 3. To be known as the eastern division, embracing watersheds of the Hudson and the Mohawk rivers and their tributaries.

Division No. 4. To be known as the northern division. The watersheds of the Champlain section, St. Lawrence river and the Black and Salmon rivers and their tributaries.

The assignments of commissioners to the several divisions were as follows:

First—Commissioners Landreth and Middleton.

Second—Commissioners Rafter and King.

Third—Commissioners Sweet and Finch.

Fourth—Commissioners Boyd and Bond.

Fourth meeting held at the Bennett house, Binghamton, June nineteenth. Informal meeting was held with the city officials and representative citizens of Binghamton to consider the matter of floods in the Susquehanna river and the feasibility of measures of prevention. Following the meeting the commissioners visited the portions of the city subject to inundations.

In business session the Commission appropriated to each divisional sub-committee for expenses of local work on the divisions the sum of $400. Commissioners Landreth and Middleton submitted an outline of the system of inspection and visitation to be followed upon the western division.

The Commission authorized the preparation of a card index of existing flood literature to be prepared by the secretary under the general direction of Commissioner Landreth. In the carrying out of the work of preparing the index, Commissioner Rafter added a large number of titles to those otherwise secured.

Fifth meeting. Powers hotel, Rochester, August twenty-first. The secretary and the four divisional committees submitted progress reports of the work of the Commission to date. Hearings were given to the officials of the city of Rochester and of the Rochester flood committee; also to delegations from the villages of Mount Morris and Geneseo. The entire day following was devoted to a trip by special train furnished by the Rochester flood committee over the Pennsylvania railroad along the Genesee river as far as Houghton, Allegany county, stopping at various points along the river and visiting the proposed reservoir sites at Mount Morris and Portage.

The following is an extract of the secretary's report setting out the circular work as ordered by the Commission:

"The work at the capitol office began by the printing of circulars and letters authorized by the Commission. The circulars were mailed as follows:

Legislators and others connected with legislation	350
Mayors and others connected with city administration	250
Presidents of villages and others connected with village administration	450
Supervisors and others connected with county administration	300
Miscellaneous	400
	1,750

Sixth meeting held at the capitol, Albany, November eleventh. The Commission voted to close up the divisional reports by December first. Commissioners Sweet and Landreth were elected a committee to prepare a draft of the final report. After recess the Commission met at the rooms of the Albany Chamber of Commerce and received reports from that organization and from sub-committees from adjoining cities and towns which had been co-operating with the Albany Chamber of Commerce. In the evening of that day the Commission was given an informal reception by the University club of Schenectady, at which Commissioner Bond outlined the scope of the work being carried on by the Commission. On the morning of November twelfth the Commission met at the Edison hotel, Schenectady, and heard delegations from the city and suburban points concerning the matter of floods along this portion of the Mohawk river. The Commission then took a special train furnished by courtesy of the New York Central railroad, and visited several points along the Mohawk river, stopping at Amsterdam, Fonda, Canajoharie, Little Falls, Herkimer, Utica and Rome.

Seventh meeting, held at the office of the Commission in the capitol December twenty-ninth and thirtieth.

Two delegations, one from Auburn and one from Canajoharie, appeared before the Commission with reference to flood conditions on the outlet of Owasco lake and Canajoharie creek, respectively. The information and statistics gathered from the four divisions of the State were fully discussed and the general tenor and scope of the report of the Commission considered and adopted. The matter of legislation necessary to render feasible and to carry out public improvements for the prevention of floods, the reclaiming of the larger swamp areas in the State

and the storage of water was fully discussed and recommendations agreed upon.

Eighth meeting, held at the capitol office on January eighth.

Hon. John Cunneen, who became a member of the Commission by virtue of his succeeding Hon. John C. Davies as Attorney-General was present and was unanimously chosen permanent chairman in place of Attorney-General Davies, retired. The work of the Commission was gone over with the new chairman and further discussion of several points in the final report was had.

Mr. William B. Jones, as secretary, submitted a communication from the Albany Chamber of Commerce relative to the present existence of two ice gorges in the Hudson river just below Albany.

It was the intention of the Commission by dividing the State into divisions, that the two commissioners assigned to each division should confine their efforts to the detailed study of the conditions prevailing in their respective divisions.

It is clearly evident that within the short time available and with the meagre appropriation furnished the Commission, no exhaustive or comprehensive study of flood conditions could be accomplished, and the Commission, therefore, has confined itself to the very necessary preliminary work of collecting general information concerning the distribution and extent of floods throughout the State; to the ascertainment of the general character and extent of the injuries suffered thereby; and to the determination of the general type and character of remedial measures available.

It was expected, as has been realized, that the preliminary investigation of the first year would show to the Commission

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just what problems existed and what further special investigations and surveys were needed before actually undertaking the work of flood prevention or stream improvement in the various portions of the State.

RESULTS AND CONCLUSIONS.

The data collected by the various sub-committees, whose reports are annexed to and form a part of this report, show damages caused by floods in this State during 1902 aggregating more than three million dollars. The reports from which the amount of these damages are compiled are very incomplete, and doubtless greatly understate the total damage from this cause. These pecuniary damages are by no means the only injuries sustained by the citizens of the State and frequently not the worst ones. The loss and danger to life; the serious impairment of health and the causing of extremely unsanitary conditions; the physical suffering, anxiety and fear, and the serious inconvenience and interruption to private and public activity comprise a list of flood results that can neither be assessed nor compensated.

The diversity of form assumed by flood conditions throughout the State is in keeping with the variety of the results.

The destruction of bridges and roads and the resulting interruption of travel and intercourse is possibly the most common form, while the destruction of crops and fences, the denuding of the soil and interruption to agricultural operations, often at critical seasons, constitute one of the greatest sources of damage and one common to the lands of highest fertility. Besides this, immense areas of fertile river and bottom lands are kept from being used for the most valuable purposes; valuable suburban lands and lots are kept from occupation and development; great

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numbers of houses and lots are periodically inundated with resulting damage, inconvenience and unhealthful results; sewers are flooded and rendered sources of danger rather than benefit; railroad and trolley travel is interrupted; gas and electic light systems thrown into darkness, and great numbers of factories are shut down with resulting loss to owners and employers.

The ills suffered by the people from floods are rendered the harder to bear by the knowledge that in most instances the floods themselves may be either prevented or mitigated.

The preliminary cause of floods is obviously the irregularity of the rainfall, which constitutes the only source of stream flow, and this irregularity is greatly increased in our climate because the winter precipitation largely falls in the form of snow which remains on the ground until the approach of warm weather in the spring, when rapidly melted by the sun and warm rains, it overflows the streams, creates ice gorges and the most damaging floods known on our principal rivers.

The breadth and importance of this subject of regulating the flow of streams cannot be appreciated without considering its manifold relations and effects, including not only the causes and effects of floods, but as affecting the public health and promoting navigation and the development of power.

Water is the life blood of organic, inanimate nature. Like the circulation of the blood in the animal economy, water is raised from the ocean in the form of vapor by the force of the sun, and is diffused over the earth and condensed by atmospheric currents energized by the same central force, and after performing its vital function of stimulating life and growth in the forest and the field, it gradually returns again by its venous system of

rills, brooks, creeks and rivers to the ocean. This return of the rainfall to the ocean is continuous, but exceedingly irregular.

The development of civilization finds in the unregulated operation of this great natural process, as with all the great forces of nature, many problems to solve, and it is one of the problems of engineering science to direct and regulate the forces of nature involved in the injurious irregularity of the flow of water courses for the greatest convenience and use of mankind.

Reason and experience have taught but two methods of mitigating or preventing the effects of floods which attend this great irregularity of the flow of streams. The first method is by enlarging and regulating their channels to provide sufficient waterway for the flood flow, and the second by storing the flood waters of streams in reservoirs to be used when needed to regulate their flow.

The characteristics of the watershed of each particular stream requiring flood regulation must determine which of these two methods should be employed for its improvement.

The divisional reports of our sub-committees show that there are a good many streams in the State where the topography of the watersheds does not afford available sites for storage reservoirs that can be developed within permissible limits of cost, and in these cases, if flood regulation is required, the first method must be resorted to.

These reports, however, fortunately show that most of our important streams can be regulated by storing their flood waters by reservoirs on the streams themselves or upon their tributaries at moderate cost. Wherever this latter method of flood regulation is available, it presents great and manifold advantages over the first-named plan of channel improvement—the one tending

to produce a uniform flow throughout the year, while the other retains the maximum flow within the channel of the stream without diminishing the irregularity of its flow.

Besides the prevention of freshets, the benefits arising from river regulation by storage may be considered under its four most important relations, viz.: Its relation to the public health, to navigation, the reclaiming of marshes and the development of power.

It improves sanitary conditions by affording a pure municipal water supply to many cities and villages; by preventing malarial conditions from decaying vegetation resulting from the overflow of streams; by permitting the full operation of city and village sewer systems now periodically interfered with by freshets, by greatly increasing the low water flow of streams carrying sewage, thus preventing the nuisances now prevalent along them during the dry season; and by doing away with the privation, exposure and hardship so conducive to disease in flooded districts during freshets.

Closely allied to the matter of floods, lies the case of the extensive areas of swamp lands and lands inundated regularly and for a considerable time each year. These aggregate not less than 200,000 acres and include some of the most fertile and productive lands in the State when properly drained and cultivated. A considerable part of these lands is entirely withdrawn from cultivation, and, of course, substantially from taxation; other portions can only be used for low grade agricultural purposes, such as pasturing during a short portion of the year; others still can only be used during dry years. The remedies needed to reclaim these lands in general are the same as those required for flood prevention where regulation must be resorted to, and include gen-

erally the lowering, enlarging or straightening of the drainage channels through these lands.

Water storage on many rivers of the State would furnish the additional feed water required for improved canals, and the carrying out of the entire storage system outlined in the sub-committee's report of the eastern division would greatly promote the navigation of the upper tidal section of the Hudson, not only by increasing its minimum depth over a foot, but by doing away with flood currents which, by carrying great quantities of sand and sediment, continually form bars, involving costly dredging operations in this part of the river and by rendering the docks and slips always accessible.

The greatest benefit to the future growth and prosperity of the State, to be anticipated from this method of river improvement, however, is that it renders available the vast amount of energy stored by the sun in the surplus rainfall which flows from a great part of its higher watershed.

When we consider that the flood flow of most of the larger streams is from 50 to 100 times the minimum flow, and that the difference between flood and low water flow in many of their tributaries is much greater, and that the greatest monthly flow is from 20 to 50 times the least monthly flow, the necessity for their regulation for the development of power becomes apparent.

Let us take for concrete examples the Genesee, the Black river and the upper Hudson. The Genesee has a watershed of about 2,400 square miles, with a maximum flow of over 40,000 cubic feet and a minimum flow of less than 300 cubic feet a second. The water powers developed on this stream are rated at 23,000 horse power. They are, however, supplemented by steam plants and if rated on the water power alone afforded by the low water

flow would aggregate less than 6,000 horse power. If the Genesee were regulated by water storage as planned by Mr. Rafter, it would furnish 57,000 reliable horse power.

The Black river has a watershed of about 1,900 square miles, a maximum flow of over 30,000 cubic feet a second and a minimum flow of less than 500 cubic feet per second. The water powers developed on the Black river are rated at 76,000 horse power. They must be supplemented by steam plants to furnish this amount of power in dry times, and if rated on the low water flow would not aggregate more than 30,000 horse power. If the flow of Black river were controlled by storage, as is undoubtedly practicable, it would render over 120,000 horse power available on this stream.

The Hudson river, above Troy, affords a more striking illustration of the value of water storage for the development of power, by reason of the higher elevation at which the topography of its watershed permits the principal storage reservoirs to be located. It has a watershed of about 4,500 square miles, a maximum flow of about 60,000 cubic feet and a minimum flow of less than 1,500 cubic feet per second. The water power now developed on this part of its watershed is rated at 70,000 horse power.

Most of these developments of power require the assistance of steam in dry season and if rated upon their reliable hydraulic efficiency would not exceed an aggregate of 35,000 horse power. If we assume the conservative estimate of 60 per cent. efficiency of the regulated flow from this watershed to be secured by the system of storage outlined in the report of the eastern division, we would have upon it not less than 260,000 horse power or an increase of 225,000 reliable horse power. The additional power thus derived every year from storage would represent on the Gen-

esee the efficient power that can be derived from 450,000 tons of coal, on the Black river from 800,000 tons of coal, and from 2,000,000 tons on the Hudson. The cost of these improvements, as shown by the divisional reports, bear but a small proportion to the value of the benefits that would accrue to the State.

These examples representing sections of the State to which the principal studies of storage conditions have been heretofore directed represent only a fraction of the possibilities in this direction.

In view of the fact that our agricultural resources are pretty fully developed and that the recent growth of the State has been largely dependent, and that its future progress and prosperity must largely depend upon the growth of manufacturing industries, the success of which requires cheap power, and that cheap electrical transmission renders the development of power by storage available far from its source, we believe that this method of river regulation has become a public utility of the first order, and the fact that every improvement of this kind tends to improve sanitary conditions and to mitigate floods and in many instances to improve navigation, increases its importance and urgency. There are some streams, however, where devastation by floods can only be prevented by the method of channel regulation and this method should be included in the general system of river regulation.

There are many groups of individuals and many corporations whose interests would long since have induced them to carry out one or the other of these methods of regulating streams, but they find it impracticable to do so under the present law of waters and water courses in this State, which give to every riparian owner, however small and insignificant be his holding, the power

to enjoin any change in the natural condition of the stream his holding abuts upon, however salutary its regulation might be to his own interests and of however vital importance the regulation may be to the whole community affected.

It is largely owing to this mediaeval condition of our law of waters that we are so far behind many of our sister States in the development of manufacturing industries by utilizing water power, as these States confer by "mill acts" the right of eminent domain under certain regulations to individuals and corporations for this purpose.

The same difficulties in effecting improvements are met in reclaiming marshes as in flood prevention. Mutual effort without some central official agency is inadequate to carry through the needed measures. The existing State drainage law was enacted in 1869, and in the attempt to make it effective has been amended almost every year since that time. This law meets fairly well the case of the reclamation of small tracts where but a few interests are involved, but is inadequate in the case of large undertakings, and though it has repeatedly been attempted, it has never yet been applied to the several large areas awaiting reclamation.

A system that would give a broad, comprehensive treatment of the State water courses would include properly the consideration of the problem of the drainage and reclamation of the large areas of swamp and wet lands in the State in common with flood prevention, and it is entirely feasible to frame a general law which shall provide both these important subjects.

The time has, therefore, arrived in this State when the continued denudation of forests has intensified freshet conditions,

when electrical progress has rendered power in small units economically available long distances from interior sources of generation of water power and when the sanitary requirements of increasing urban population, the demand for draining marshes and the increased development of internal water communication, render such mill acts inadequate and demand that we take an advanced position in this matter of river regulation.

The intelligent application of the principles of river regulation, whether by storage of the flood flow or by the improvement of the channel, has become of too broad a significance to be entrusted to the initiative of individuals, localities or corporations.

All experience here and abroad has demonstrated that no improvement of a river by dyking, straightening or enlarging its channel can safely be undertaken except by treating the river as a whole from source to mouth, and that the principles governing the intelligent regulation of the flow of streams by storage reservoirs, viz.: That for the prevention of dangerous floods the stream must be put under control throughout the districts damaged by floods, and that for the highest development of power the storage required for regulation should be distributed ratably upon all the tributaries according to the area of their respective watersheds, and at as great an elevation as is consistent with the certain repletion of the various reservoirs.

The fulfillment of these requirements clearly could not be expected if this class of improvements were left to the desultory results of individual or corporative initiative, as is done in the mill acts of various States in this country.

We believe that State supervision and control is the only safe method of intelligently initiating, constructing and maintaining an adequate system of river improvement in this State. Such State supervision and control, by a commission of recognized competence and character, would not only secure the scientific treatment of such stream as a whole, but the safe and economical execution of the various component parts of a comprehensive system of river improvement in the order of their relative urgency and importance. Legislation providing for such a system of river regulation is in our opinion a great and urgent public necessity.

We believe such legislation should embrace the following essential features:

It should entrust the inauguration and execution of the system to a permanent commission.

The central idea should be that the entire cost of the execution and maintenance of each of the various separate works comprising such a system should be borne by the beneficiaries in proportion to the benefits they respectively derive from it.

The initiative of a work of improvement under this act should be by publication by the commission of a notice of intention to make the improvement or by petition by riparian owners showing facts from which they deem it necessary to regulate the flow of the stream in the interest of the public health or safety, and notice to all interested of time and place to hear objections.

It should be made the duty of such commission to investigate the subject matter presented in such petitions and to approve or disapprove the work they contemplate. If they approve the work, the act should empower and direct them to prepare the

necessary maps, plans, specifications and estimates and to execute the work by contract, and stringent regulations and safeguards should be provided in the act for its execution in this matter.

For the acquisition of the necessary property rights the act must obviously confer the right of eminent domain, and it should clearly provide adequate machinery for carrying out condemnation proceedings, reserving the right of appeal conferred by similar statutes of this State.

When the entire cost of any such work of improvement shall have been ascertained, the act should make it the duty of the Water Storage Commission to assess the aggregate cost of each improvement equitably upon all the beneficiaries in proportion to the benefits accruing to each, and to provide methods of collection conformable to the tax provisions of our statutes.

To insure the progress of such improvements without financial hardship upon the beneficiaries, the act should provide for the issue of bonds limited in amount to the aggregate assessments upon such beneficiaries and secured by such assessments as is done in all important public improvements, and providing in the usual manner for sinking funds and interest charges and the cost of maintenance in determining the yearly taxable assessments.

We are firmly convinced that the prompt inauguration of such a policy by the Legislature would more profoundly influence the progress and prosperity of the commonwealth than any public enterprise to which its attention can be directed.

The cost of the system of river improvements provided by such legislation would fall entirely upon the beneficiaries of the several works of improvement, except such expenditures as may

be incurred by the commission in the investigation of such of the projects brought before it by petition as it finds it necessary or expedient after careful examination to disapprove, for which expenditure there would be needed a small annual appropriation by the Legislature.

The attention of the Legislature is respectfully invited to the appended reports of the four division sub-committees, which discuss the causes of floods and methods of prevention on the several divisions and are accompanied by interesting and valuable local reports.

Additional maps and data derived from surveys made by us, now in course of preparation, will be added to the appendices of this report at an early date.

Financial Statement.

Appropriation for the Commission under chapter 406 of the Laws of 1902	$5,000 00

The following are the expenditures by months for office expenses, printing, Commissioners' traveling expenses and secretary's salary:

1902.

May	$79 04
June	379 99
July	469 73
August	476 22
September	344 23
October	793 43

November	$911 58
December	548 87
1903.	
January	272 41
Total expenditures to January fifteenth	$4,270 50
Appropriation	$5,000 00
Expended	4,270 50
Balance January fifteenth	$729 50

Respectfully submitted,

JOHN CUNNEEN,
Chairman.
EDWARD A. BOND.
CHARLES S. BOYD.
D. C. MIDDLETON.
OLIN H. LANDRETH.
JOHN L. KING.
ELNATHAN SWEET.
GEORGE W. RAFTER.
GEORGE R. FINCH.

PART II.

REPORT

OF THE

Commissioners Representing the Four Divisions of the State.

REPORT OF THE FIRST OR WESTERN DIVISION

COMPRISING THE WATERSHEDS OF THE GENESEE, CHEMUNG, AND ALLEGANY RIVERS, AND ALL STREAMS OF THE STATE WEST OF THESE RIVERS.

Commissioner LANDRETH.

Commissioner MIDDLETON.

PHYSICAL CHARACTERISTICS.

Extent.—The Water Storage Commission, in dividing the State into four divisions to permit of a greater concentration of effort of the commissioners, assigned to this division all that part of the State lying west of a line from Lake Ontario to the Pennsylvania line following the eastern boundary of the Genesee river watershed and the northerly boundary of the Chemung river watershed, comprising an area of about 9,800 square miles, and a present population of 1,200,000 people.

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Streams.— The streams included in this division are these:

The Genesee river and tributaries within the State.
The Allegany river and tributaries within the State.
The Chemung river and tributaries within the State.
The streams emptying into Lake Erie and Niagara river.
The streams emptying into Lake Ontario.

Topography.—Although this division does not contain the highest points in the State, the general elevation of the country is higher than that of either the three other divisions and includes drainage areas tributary to the Gulf of St. Lawrence, the Chesapeake Bay and the Gulf of Mexico.

The general elevations of the country above sea-level vary from 300 feet along the country bordering on Lake Ontario to 2,000 feet in portions of Wyoming and Steuben counties.

The topography varies from the prairie-type, covering a zone skirting Lake Ontario and Lake Erie, to the mountain type in Steuben county. For the entire division a general statement would classify:

One-fifth of the territory as "flat."
Two-fifths of the territory as "rolling."
One-fifth of the territory as "hilly."
One-fifth of the territory as "mountainous."

Geological Formation.— Geologically the district is banded by strips or zones of surface formations extending east and west across the entire district. Arranged in order these formation zones are as follows, each extending from the eastern boundary of the district to Lake Erie or the Niagara river:

Beginning at Lake Ontario on the north there occur—

Medina sandstones, averaging nine miles wide, aggregating 675 square miles.

Niagara and Clinton shales and limestones, averaging six miles wide, aggregating 460 square miles.

Salina shales and limestones, averaging seven miles wide, aggregating 500 square miles.

Helderberg limestones, averaging four miles wide, aggregating 270 square miles.

Hamilton shales and sandstones, averaging nine miles wide, aggregating 430 square miles.

Devonian sandstones and shales, averaging forty-five miles wide, aggregating 7,500 square miles.

The large areas of shale and limestone formation suggest a soil tending toward the impervious, and this fact, coupled with the abrupt character of the typography for the southern half of the division, accounts for the rather sudden rises to which many of the streams are subject.

Rainfall.—From the report of the United States Deep Water Way Survey of 1899, the following table of annual rainfalls at points on this division is given:

TABLE I.

Place of observation.	Annual rainfall.	Elevation. above sea.	Years of record.
Rochester	33.61	523	64
Avon	29.67	585	5
Hemlock Lake	27.56	....	20
Mount Morris	27.44	900	8
Alfred	38.03	1,792	9
South Canisteo	43.84	1,480	9
Addison	38.60	1,000	8
Elmira	34.79	863	17
Waverly	37.19	824	9
Leroy	45.24	888	5
Wyoming	30.61	800	12
Arcade	41.94	1,707	8
Angelica	40.88	1,340	10
Friendship	37.90	1,550	5
Bolivar	38.92	1,800	7
Little Genesee	38.39	....	8
Humphrey	46.09	1,950	10

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FLOOD CONDITIONS.

Circulars.—Copies of the circular information blanks sent out from the office of the Commission were returned filled out from the following gentlemen on this division:

TABLE II.

GENESEE WATERSHED.

Name and address.	Stream.
Mr. A. B. Richardson, Andover, Allegany county	Dyke's Creek.
Mr. C. D. Buchanan, Angelica, Allegany county	Black Creek.
Mr. M. J. Becker, Canadice, Ontario county	Inlet to Hemlock lake and outlet to Canadice lake.
Mr. Walter J. Miller, Burns, Allegany county	Canaseraga creek.
Mr. W. Say, Mendon, Monroe county	Honeoye creek.
Mr. Alex. W. Smith, Mount Morris, Livingston county	Genesee and Canaseraga creek.
Mr. H. H. Reed, Richmond, Ontario county	Honeoye outlet.
Mr. John M. Ives, City of Rochester, Monroe county	Genesee river.
Mr. C. H. Hain, Warsaw, Wyoming county	Oatka and Allen's creeks.

ALLEGANY WATERSHED.

Mr. E. E. Allen, Olean, Cattaraugus county	Allegany river and Olean creek.
Mr. David E. Barrows, Olean, Cattaraugus county	Allegany river and Olean creek.
Mr. J. F. Johnson, Olean, Cattaraugus county	Allegany river and Olean creek.
Mr. H. A. Ostrander, Salamanca, Allegany county	Allegany river.
Mr. T. J. Newell, Sherman, Chautauqua county	French creek.
Mr. D. C. Mills, Wirt, Allegany Co	

CHEMUNG WATER SHED.

Mr. John Hinman, Addison, Steuben county	Canisteo river and Tuscarora creek.
Mr. Chas. S. Straight, Ashland, Chemung county	Chemung river and Bentley creek.

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Name and address.	Stream.
Mr. J. A. Almy,	
Canisteo, Steuben county.....	Canisteo river,
	Bennett's creek,
	Purdy creek.
Mr. John J. Crowley,	
Elmira, Chemung county.....	Chemung river,
	Seeley creek,
	Newton creek,
	Bentley creek.
Mr. Chas. H Knipps,	
Elmira, Chemung county.....	Chemung river,
	Newton creek,
	Seeley creek,
	Bentley creek.
Mr. Oscar Woodruff,	
North Dansville, Livingston county...	Canaseraga creek,
	Big Mill creek,
	Little Mill creek.
Mr. D. R. Sett,	
Van Etten, Chemung county.....	Cayuta creek.
Mr. F. B Shelton,	
Van Etten, Chemung county.....	Langford creek and Shepard's creek.

LAKE ERIE AND NIAGARA RIVER WATERSHEDS.

Mr. H. B. Harrington,	
Alexander, Genesee county.....	Tonawanda creek.
Mr. B. F. Couch,	
Buffalo, Erie county.....	Tonawanda creek.
Mr. John B. Haugh,	
Brant, Erie county.....	Cattaraugus creek.
Mr. D. Scannell,	
Dunkirk, Chautauqua county.....	Canadaway creek,
	Douglass creek.
Mr. John T. Darrison,	
Niagara county.....	Tonawanda creek and Mud creek.

LAKE ONTARIO WATERSHED.

Mr. Joseph S. Wilford,	
Elba, Genesee county.....	Tonawanda creek and Oak Orchard creek.
Mr. V. A. Acer,	
Shelby, Orleans county.....	Oak Orchard creek and Oak Orchard feeder.

Inspection.—The following places have been visited and inspected by one or both the two Commissioners assigned to the divison:

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Addison,	Corning,	Oak Orchard Swamp,
Angelica,	Cuba,	Olean,
Attica,	Elmira,	Portage,
Batavia,	Hornellsville,	Rochester,
Belfast,	Lockport,	Shelby,
Belmont,	Medina,	Tonawanda,
Buffalo,	Mt. Morris,	Warsaw,
Canisteo,	North Tonawanda,	Wellsville,

Localities flooded.—The following places on the division are subject to more or less frequent occurrence of severe floods:

TABLE III.

GENESEE WATERSHED.

Locality.	Stream.
Angelica,	
Allegany county	Angelica creek.
Belfast,	
Allegany county	Angelica creek.
Belmont,	
Allegany county	Angelica creek and Phillips creek.
Caneadea,	
Allegany county	Genesee river
Canaseraga,	
Allegany county	Canaseraga river.
Freemont,	
Allegany county	Genesee river.
Houghton,	
Allegany county	Genesee river.
Mt. Morris,	
Livingston county	Genesee river.
Oramel,	
Allegany county	Genesee river.
Portage,	
Wyoming county	Genesee river.
Piffard,	
Livingston county	Genesee river.
Rochester,	
Monroe county	Genesee river.
Rossburg,	
Allegany county	Genesee river.
Scottsville,	
Monroe county	Allen creek and Genesee river.
Warsaw,	
Wyoming county	Oatka creek.

Name and address.	Stream.
Mr. J. A. Almy, Canisteo, Steuben county	Canisteo river, Bennett's creek, Purdy creek.
Mr. John J. Crowley, Elmira, Chemung county	Chemung river, Seeley creek, Newton creek, Beritey creek.
Mr. Chas. H. Knipps, Elmira, Chemung county	Chemung river, Newton creek, Seeley creek, Bentley creek.
Mr. Oscar Woodruff, North Dansville, Livingston county	Canaseraga creek, Big Mill creek, Little Mill creek.
Mr. D. R. Sett, Van Etten, Chemung county	Cayuta creek.
Mr. F. B. Shelton, Van Etten, Chemung county	Sangford creek and Shepard's creek.

LAKE ERIE AND NIAGARA RIVER WATERSHEDS.

Mr. H. B. Harrington, Alexander, Genesee county	Tonawanda creek.
Mr. B. F. Couch, Buffalo, Erie county	Tonawanda creek.
Mr. John B. Haugh, Brant, Erie county	Cattaraugus creek.
Mr. D. Scannell, Dunkirk, Chautauqua county	Canadaway creek, Douglass creek.
Mr. John T. Darrison, Niagara county	Tonawanda creek and Mud creek.

LAKE ONTARIO WATERSHED.

Mr. Joseph S. Wilford, Elba, Genesee county	Tonawanda creek and Oak Orchard creek.
Mr. V. A. Acer, Shelby, Orleans county	Oak Orchard creek and Oak Orchard feeder.

Inspection.—**The following places have been visited and inspected by one or both the two Commissioners assigned to the division:**

Addison,	Corning,	Oak Orchard Swamp,
Angelica,	Cuba,	Olean,
Attica,	Elmira,	Portage,
Batavia,	Hornellsville,	Rochester,
Belfast,	Lockport,	Shelby,
Belmont,	Medina,	Tonawanda,
Buffalo,	Mt. Morris,	Warsaw,
Canisteo,	North Tonawanda,	Wellsville.

Localities flooded.—The following places on the division are subject to more or less frequent occurrence of severe floods:

TABLE III.

GENESEE WATERSHED.

Locality.	Stream.
Angelica,	
Allegany county	Angelica creek.
Belfast,	
Allegany county	Angelica creek.
Belmont,	
Allegany county	Angelica creek and Phillips creek.
Caneadea,	
Allegany county	Genesee river.
Canaseraga,	
Allegany county	Canaseraga river.
Freemont,	
Allegany county	Genesee river.
Houghton,	
Allegany county	Genesee river.
Mt. Morris,	
Livingston county	Genesee river.
Oramel,	
Allegany county	Genesee river.
Portage,	
Wyoming county	Genesee river.
Piffard,	
Livingston county	Genesee river.
Rochester,	
Monroe county	Genesee river.
Rossburg,	
Allegany county	Genesee river.
Scottsville,	
Monroe county	Allen creek and Genesee river.
Warsaw,	
Wyoming county	Oatka creek.

Locality	Stream
Wellsville,	
Allegany county	Genesee river and Dyke creek
York,	
Allegany county	Genesee river.

CHEMUNG WATERSHED.

Addison,	
Steuben county	Canisteo river.
Bath,	
Steuben county	Cohocton river and Canisteo river.
Corning,	
Steuben county	Chemung river.
Canisteo,	
Steuben county	Canisteo river.
Elmira,	
Chemung county	Chemung river
Hornellsville,	
Steuben county	Canisteo river.
Painted Post,	
Steuben county	Cohocton river.

ALLEGANY WATERSHED.

Cattaraugus Swamp,	
Cattaraugus and Erie counties	Cattaraugus creek.
Conewango Swamp,	
Cattaraugus and Chautauqua counties	Conewango creek.
Olean,	
Cattaraugus county	Allegany river and Olean creek.
Salamanca,	
Cattaraugus county	Allegany river.
Sherman,	
Chautauqua county	French creek.

LAKE ERIE AND NIAGARA WATERSHED.

Arcade,	
Wyoming county	Cattaraugus creek.
Attica,	
Wyoming county	Tonawanda creek.
Batavia,	
Genesee county	Tonawanda creek.
Buffalo,	
Erie county	Buffalo river and Cazenovia creek.
North Tonawanda,	
Erie county	Tonawanda creek.
Royalton,	
Niagara county	Tonawanda creek.

LAKE ONTARIO WATERSHED.

Locality.	Stream.
Oak Orchard Swamps, Genesee and Orleans counties	Oak Orchard Swamp.
Shelby, Orleans county	Oak Orchard creek.
Elba, Genesee county	Tonawanda creek and Oak Orchard creek.

Lakes and Marshes.—This division is peculiarly free from lakes The only lakes of appreciable size are the following:

TABLE IV.

Lakes.	Water surface (sq. miles).	Drainage area (sq. miles).
Canadice	2.0	14.
Chautauqua	25.	185.
Conesus	5.	70.
Hemlock	4.	37.
Honeoye	3.	35.

There are, however, several large areas of swamp and lowlands which, in wet seasons, are flooded and which have, therefore, conserving influences on the run-off of their streams. These are particularly the marshy areas of Oak Orchard creek, Tonawanda creek and Conewango creek. The larger of these two swamp areas, namely, the Oak Orchard and the Tonawanda, are comprised within the drainage area directly tributary to Lake Ontario and Niagara river respectively, and hence have no conserving effect on the larger rivers of this division. The Conewango is tributary to the Allegany river, but as it joins that stream after the latter leaves New York, it has no effect on the Allegany river within New York.

Stream Profiles.— The streams of this division have the characteristically concave profiles of streams draining hilly and mountainous country, with declivities steepest at the headwaters, and in the lateral tributaries, growing flatter toward the mouths.

On streams in general having this concave type of profile, it is customary to divide them into three portions; first, the upper or terrential portion or compartment, where erosion is active and in excess of deposition; second, the normal compartment, where erosion and deposition are about equal, and the stream is neither lowering nor raising its bed; and third, the alluvial compartment, where deposition exceeds erosion, and where the bed is gradually being raised and where, also, this raising of the bed and the friable and alluvial character of the banks permit of sudden and extensive changes of channel location at times of floods. This concavity of profile, with its resulting diminution of stream velocity, is one of the potent factors in the causation of floods; since it permits flood waters to be brought to points having sharp concavities of profile or of abrupt flattening of grades more rapidly than the channel will carry the same away, producing at such points temporary accumulations of water.

It is not to be understood that the profile of any stream is a perfectly smooth concave curve; nor that the grades grow progressively flatter without interruption as one passes down stream. Local causes interfering with regularity of flow, and geological formation interfering with the vertical erosion of channels, cause interruptions in the regularity of the concave profile. The Genesee river is a characteristic type of this interruption by geological causes, as will be seen later. Whatever the regularity or irregularity of the profile may be, however, it is safe to expect that if floods occur at all on a stream, they are more certain to occur where the stream slope grows suddenly or decidedly flatter or where extensive local obstructions or restrictions occur.

Forest Areas.— Recognizing forestation of country as an important element tending to regularize the run-off from drainage areas, it is proper to say that a very large proportion of the entire division has been cleared of its timber, and is now under cultivation or grazing. It has not been possible to make an accurate determination of this element, but it would seem to be an approximately correct estimate to give the following

percentages as still remaining in timber or in heavy brush; this estimate is formed from the census taken by the United States Forestry Bureau in 1875, and has been modified to cover the estimated reduction in forest areas since that date:

TABLE V.

PERCENTAGE OF WATERSHED AREA IN FOREST.

1903.

Watersheds.	Percentage in forest.
Genesee	10
Chemung	20
Allegany	25
Lake Erie and Niagara river	12
Lake Ontario	8

Having considered this entire division as a whole, it will now be appropriate to consider in detail the five separate watersheds.

GENESEE WATERSHED.

The Genesee river rises in Potter county, northern Pennsylvania, and flows northerly across New York State, emptying into Lake Ontario at Charlotte, six miles north of Rochester. The river has a total length of about 140 miles and a drainage area of 2,450 square miles. It rises at an approximate elevation of 2,500 feet above sea level, falls 1,100 feet in the first thirty-five miles of its flow to Belmont, 295 feet in the next thirty-five miles to Portage, where it drops 330 feet over the three Portage falls into a deep chasm which it follows for sixteen miles to Mt. Morris, falling on the way 180 feet. At Mt. Morris it emerges from the canon into a broad alluvial valley from one to two miles in width, through which it flows to Rochester, forty-six miles below, falling seventy feet in this distance. At Rochester it again drops into a chasm by a series of two falls which aggregate 240 feet in height, thence flows through this chasm to Lake Ontario, seven miles north, falling seven feet in this distance.

The following table gives the data relating to the drainage areas, elevations and slopes of the Genesee river from its source to its mouth:

TABLE VI.

DATA CONCERNING GENESEE RIVER.

POINT ON RIVER.	Distance from source — Miles.	Drainage area — Square miles	Elevation of river surface — Feet.	Fall — Feet.	Fall per mile — Feet.	
Source in Pennsylvania	.....	.....	2,500	700	41	Torrential.
State Line	17	200	1,800	420	23	Torrential.
Belmont	35	.....	1,350	295	8.7	Normal and alluvial.
Portage (above dam)	69	1,000	1,085	10	10	Normal.
Portage (head upper falls.)	70	.....	1,075	330	.....	Falls and cascades.
Portage (foot lower falls)	72	.....	745	180	13	Canon.
Mt. Morris (above dam)	86	1,070	565	57	1.3	Alluvial.
Rochester (above feeder dam)	129	2,425	508	13	4.3	Artificial obstructions.
Rochester (head upper falls)	132	.....	495	240	.....	Falls and cascades.
Rochester (foot lower falls)	134	.....	255	8	1.3	Canon.
Charlotte (mouth)	140	2,450	247	.....	.....	

The principal tributaries to the river, with their respective drainage areas, are given in the following table:

TABLE VII.

PRINCIPAL TRIBUTARIES OF GENESEE RIVER ARRANGED IN THEIR RESPECTIVE ORDER FROM MOUTH TO SOURCE.

LEFT BANK.		RIGHT BANK.	
Tributary.	Drainage area — square miles.	Tributary.	Drainage area — square miles.
Black Creek (Monroe county)	200	Hemlock Outlet	290
Allen Creek	215	Conesus Outlet	100
Silver Lake Outlet	33	Canaseraga Creek (Kushaqua Creek)	345
Black Creek, Cuba Reservoir Outlet (Allegany county)	50	Angelica Creek	93
Van Campen's Creek	60	Phillips Creek	33
Knight's Creek	15	Dyke's Creek	70

The greater number of these tributaries contain alluvial sections and suffer flooding in their own valleys, while the remaining ones, together with the numerous smaller tributaries not enumerated above, are almost wholly torrential to their confluence with the river, and thus not only contribute larger amounts of flood water without the conserving detention of alluvial storage which the flatter tributaries offer, but they also reach the river loaded with silt and rolling large amounts of

sand, gravel and small boulders, which play an important part in the raising of the river bed and in changes of its channel. This detritus brought down by torrential tributaries is frequently washed over the alluvial lands at the points of confluence and covers the fertile soil with coarse, sterile, material, ruining the land for cultivation.

The location of flood districts on the Genesee river itself, independently of its tributaries, is mainly confined to the alluvial portions between Belmont and Portage Falls and to the alluvial and obstructed portions between Mt. Morris and Genesee Falls at Rochester.

While the floods in the Genesee river valley occur at certain places and with certain degrees of severity every year and occasionally several times during a year, there have been since the valley was settled a number of extremely severe and disastrous floods. The following account of some of the more severe floods of the nineteenth century is taken from the report on the Genesee River Storage made by Mr. George W. Rafter, and submitted to the State Engineer and Surveyor, January 1, 1897:

SOME SEVERE FLOODS IN THE GENESEE RIVER.

"Great floods have occurred in the Genesee river in 1815, 1835, 1857, 1865 and 1896. At a number of times between 1865 and 1896 the river has also been very high, but at no time since 1865 as severe as in 1896."

Flood of 1815.—"Beyond the mere fact that a very severe flood occurred in 1815, which overflowed the flats in the valley between Avon and Mount Morris, and the black ash swamp, which then covered the area now included in the First and Third wards of the city of Rochester, little is known as to the flood of that year."

Flood of 1835.—"The next great flood of which we have record occurred in October, 1835. Considerable damage was done to the farms in the flats. According to statements made by Harvey Ely, a former citizen of Rochester, the flow of the river in the flood of 1835 amounted to about 36,000 cubic feet per second. This statement is interesting, because the flow in the flood of

1865, so far as it can be computed from the data available, was probably not much in excess of that figure, although it may possibly have gone as high as from 40,000 to 42,000 feet per second. In the spring of 1896 the flood also approximated to the same quantity."

Flood of 1857.—"In February, 1857, a serious flood occurred in the Genesee river which carried away not only a number of buildings on the north side of the Main street bridge at Rochester, but also undermined the piers of that bridge and even finally swept away the greater part of the old structure. A new bridge was in process of construction at the time."

Flood of 1865.—"March, 1865, was a period of general high water throughout western New York. Long-continued cold weather and a heavy snowfall were followed by a sudden thaw, accompanied by rain, about the middle of March. On the sixteenth a freshet in the upper Genesee valley was reported, and on the seventeenth the water was very high at Rochester, but aside from the usual alarm manifested on such occasions, the situation was not considered specifically serious. The river, however, continued to rise during the night of March seventeenth, until the banks of the Genesee valley and Erie canals were overflowed, with the water pouring direct from the river into the canals. The river further rose above its banks until finally nearly the entire central portion of Rochester was under water. The photographs, plates 3 to 9, show the condition of some of the principal streets, as well as the height to which the river rose at that time. During the whole of the eighteenth and part of March nineteenth, the only means of transportation throughout the entire business portion of Rochester was by boat. The gas supply was cut off early in the disaster, leaving the city in darkness. The New York Central and Hudson River railroad bridge over the river was carried away, and traffic suspended on the railway for several days. The damage to property is stated to have exceeded $1,000,000."

"Rochester newspapers of March, 1865, give detailed accounts of the Genesee flood, from which it is gleaned that the damage

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must have been very severe, and may have even considerably exceeded $1,000,000."

Flood of 1893.—"A severe flood also occurred in the upper Genesee at Mount Morris in March, 1893, at which time large quantities of ice were left in the streets of the lower portion of that village, as indicated by plate 10."

Flood of 1894.—" It is very common for the flats in the vicinity of Mount Morris to be inundated with great destruction of farms and growing crops, as shown by plates 11 and 12. The flats between Mount Morris and Rochester were also inundated May 22-24, 1894, the damage to growing crops at that time amounting to many thousand dollars."

Flood of 1896.—"As shown by plate 13, the flood of April, 1896, came very near reaching the danger limit, so near, indeed, that it is now the opinion of many thinking citizens of Rochester that the regulation afforded by the proposed storage dam at Mount Morris may not be sufficient to fully protect the city from a repetition of the disaster of 1865. If the river were to again rise to the height attained in that year, the damage would inevitably be several times greater than occurred them."

The photographs which Mr. Rafter refers to in the above description of floods from plates 3 to 13 inclusive, are not reproduced here, but will be found as one of the exhibits in the report of the Rochester flood committee, which is submitted as a supplement to this divisional report.

Flood of March, 1902. — On March 1 to 15, 1902, a flood occurred which, at Rochester, lacked but little if any of reaching the height of the great flood of 1865. At Avon, twenty miles above, the high water mark reached was eight inches below that of 1865. Owing to a fortunate but unusual combination of circumstances, the damage resulting from this flood within the city of Rochester was much less than that in 1865, but only prompt and energetic measures on the part of city and canal officials and the rarest good fortune prevented the damage from exceeding that of 1865. This flood was due to the more common cause of floods on this watershed, namely, the general melting

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of the snows by warm rains. This flood reached its maximum height at Rochester on the afternoon of March third.

Flood of July, 1902.—On July fifth to ninth, there occurred a flood on the Genesee which, from the time of the year, the high stage of water in certain parts of the river, and the extent and severity of the damage arising from it on a certain portion of the watershed, is without precedent in the history of Genesee floods.

The rains over the watershed generally had been unusually heavy during the latter part of June and the early part of July, and the ground thoroughly saturated with water. On July sixth the rainfall reached a climax which culminated in a so-called "cloudburst" in the region covering the northern central portion of Allegany county. At Angelica, within this district, the rainfall on July sixth amounted to 4.5 inches. Heavier rainfalls than this have occurred occasionally on the drainage area without producing severe floods. This fact, coupled with the fact that a number of private observers unofficially claimed much heavier precipitation than the Angelica office reports, raises some doubt as to whether the Angelica station itself may not have escaped the severe downpour, or whether the marked difference in the results may be due wholly to the difference of saturation of the ground. The former alternative is rather discounted by the fact that the watershed at Angelica creek itself, of which the station is not far from the center, suffered the most severe flood in its history. This remark in fact is true of the entire watershed of the Genesee in the aggregate down as far as Portage Falls. It is well established by repeated evidence that the height which the flood attained at Portage was several feet — variously estimated at from three to five feet — higher than the highest known preceding flood, and similar evidence exists for points on the Genesee up as far as Wellsville. This is not true, however, for the lower portion of the valley. At Mount Morris the flood height attained was about that of the previous floods, but at Rochester the river showed a discharge of only about 20,000 cubic feet per second against 36,000 cubic feet per second for

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the 1865 flood and the March, 1902, flood. The excessive precipitation, therefore, must have been confined to the upper headwaters of the river.

It must not be inferred that the maximum flood discharge at Portage was less than 20,000 cubic feet per second, the discharge at Rochester. On the contrary, there is good reason to believe that the discharge at Portage with only 40 per cent. of the drainage area was very much in excess of that at Rochester, and the reasons for this are two: First, the flood height at Portage was from three to five feet higher than during former extreme floods which gave flood discharges of 40,000 cubic feet per second at Mt. Morris, which has only 7 per cent. more drainage area; these former floods must therefore have discharged not much less than 40,000 cubic feet per second at Portage; five feet, or even three feet added to the crest of these former floods indicate still greater discharges and leave little doubt that the discharge at Portage was nearly if not fully double that at Rochester. The other reason is that an examination of the hydrograph of the July flood at Rochester shows that the maximum stage of water was reached at Rochester during the afternoon of July eighth, while the maximum stage at Portage occurred during the forenoon of July sixth, indicating that the flood crest occupied more than two days in passing from Portage to Rochester; when we consider the topography of the valley between Mount Morris and Rochester, this time consumed in transit must have been accompanied by an elongation of the flood wave with a corresponding diminution of the maximum discharge per second. A determination of the discharge of this flood at Portage has been partially made, but certain levels are still wanting to complete the computation. This can be made a matter of further investigation, if needed.

A careful study of the circumstances attending this flood of July, 1902, in conjunction with the other maximum floods in the Genesee, leads to the conclusion that the maximum flood at Rochester has not yet occurred, and that by a combination of circumstances which do not seem at all improbable, a maximum flood in excess of 40,000 cubic feet per second may reasonably be expected. Had the same precipitation which occurred in

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Allegany county occurred on the northern portion of the drainage area with reasonably high water from the southern district, the flood wave would not have been elongated as it was by its flow through the alluvial valley north of Mount Morris, and as a result the wave would have been shorter but with a higher maximum discharge.

This flood of July is unique in the matter of the date of its occurrence. The other great floods have occurred in March or April, with minor severe floods occurring later. Occurring, as this did, in July, with the crops well advanced toward maturity, the resulting damage was greatly in excess of what would have occurred under similar conditions in the early spring. The destruction of crops was in itself serious. But it was a greater disaster to agricultural interests that the season was then too far advanced to permit of replanting.

REPORT OF ROCHESTER FLOOD COMMITTEE.

Soon after the appointment of the State Water Storage Commission, the mayor of the city of Rochester, acting in junction with the Rochester Chamber of Commerce, appointed a large committee of representative citizens of Rochester to investigate flood conditions on the Genesee river in the vicinity of Rochester. This committee undertook its work in a very systematic manner, and by subdividing its duties and assigning them to sub-committees, and by securing the co-operation of auxiliary committees at Geneseo and Mount Morris, it has succeeded in accumulating a large amount of valuable information concerning flood conditions and flood damages in the Genesee valley from Rochester to Belfast. The personnel of these committees was as follows:

GENERAL COMMITTEE, ROCHESTER, NEW YORK.

Hon. HENRY C. BREWSTER, *Chairman.*

Louis Antisdale.
James E. Booth.
Max Brickner.
William Carson.
Hon. Frederick Cook.
George Eastman.
H. H. Edgerton.
Charles P. Ford.

Hon. J. S. Graham.
H. B. Hathaway.
Henry Hebing.
A. B. Lamberton.
Hon. M. E. Lewis.
William O. Likly.
John E. Morey.
Daniel B. Murphy.
M. J. O'Brien.
Joseph O'Connor.
Col. Nathan P. Pond.
Pierre Purcell.
L. P. Ross.
Hon. W. A. Sutherland.
Hon. John Van Voorhis.
Sol Wile.

SUB-COMMITTEE ON SCOPE OF THE ROCHESTER COMMITTEE.

Hon. A. J. RODENBECK, *Chairman.*

Hon. William A. Sutherland.
Henry B. Hathaway.
Lewis P. Ross.
Daniel B. Murphy.

SUB-COMMITTEE ON STATISTICS OF THE ROCHESTER COMMITTEE.

E. A. FISHER, *Chairman.*

J. Y. McClintock.
E. Ocumpaugh.
Pierre Purcell.
J. J. Mandery.
H. S. Woodworth.

AUXILIARY COMMITTEES.

Geneseo, N. Y.
R. L. Doty.
George Austin.
W. W. Willard.

Mt. Morris, N. Y.
John F. Connor.
John F. Donovan.
H. E. Brown.

The report of this committee was submitted to the Water Storage Commission in September, and was accompanied by the following exhibits:

TABLE VIII.

EXHIBITS ACCOMPANYING ROCHESTER REPORT.

No. 1. Table giving elevations of the Genesee river at Court street dam in Rochester.

Nos. 2, 3 and 4. Views showing conditions existing in Genesee river on March 3, 1902.

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No. 5. Extracts from "Mt. Morris Enterprise" and "Livingston Democrat," July 9, 1902; "Mt. Morris Enterprise," July 16, 1902, and "Mt. Morris Union," July 31, 1902.

No. 6. Extracts from "Union and Advertiser," Rochester, of March 3, 4 and 5, and July 7, 8, 9 and 10, 1902.

No. 7. Map showing elevations of high water in city and approximate territory flooded.

No. 8. Diagram showing hourly elevations of the Genesee river at Court street dam during floods of March and July, 1902.

No. 9. Diagram showing monthly maximum elevations of the Genesee river from March, 1893, to August, 1902.

No. 10. Profile showing elevations of the flood flow of the Genesee river in 1865, 1873, 1879, 1893, 1894, 1896 and 1902.

No. 11. Weather Bureau Report for February, 1902.

No. 12. Weather Bureau Report for March, 1902.

No. 13. Weather Bureau Report for July, 1902.

No. 14. Testimony taken at Mt. Morris and Geneseo, July 31 and August 1, 1902, by Mayor Rodenbeck and E. Ocumpaugh, relative to damages by flood.

No. 15. Report of George W. Rafter, engineer in charge of the Genesee River Storage Surveys.

No. 16. High water marks along Pennsylvania railroad.

No. 17. Report of River Committee, 1866.

Among other subjects investigated by the Rochester committee was that of the measure of damage sustained by various interests along the flooded portions of the river. As a result of such inquiry the committee is of the opinion that the damages incurred on the river from Rochester to Belfast may conservatively be placed at $800,000, which does not include damage to railroads from the destruction of roadbeds and interruption of traffic, nor the loss to the general public adjacent to flooded areas arising from the interruption to travel on the highways. Neither does it include any damages arising from unsanitary conditions.

The Rochester committee's investigation extended as far as Belfast; this does not, however, cover the entire portion of the river subject to frequent and severe floods. The flood of July, 1902, was peculiarly disastrous at Angelica on Angelica creek, one of the tributaries of the river, and at Belmont, where the river is joined by Phillips creek. Probably no municipality in the State suffered in proportion to its size as seriously as did Angelica. The disaster there was due in large measure to the peculiar topographic conditions of the place; Angelica creek drains a region of rough, hilly country and reaches the village of Angelica with an uninterruptedly strong descent; at the lower end of the village the creek, in time past, has cut a chasm through a hill which as a barrier of outflow must have formed a natural depression or lake. The width of the channel through the chasm, while ample for ordinary floods, does not permit of relief at excessive floods, as the banks are precipitous and the channel narrow. As a result, when the large amount of water following the heavy rain of July fifth reached this point, an excessive rise in creek level through this gorge caused the water to back up and flood a large portion of the village territory. The depth of submergence and the high velocity produced great damage in the destruction of buildings, bridges, streets, roads, fences, gardens and yards that is without parallel in its severity in the State.

After the examination of the flooded conditions at Angelica by the two commissioners, a local committee was appointed to collect statistics of flood damage and to submit a descriptive statement of the flood conditions at Angelica. This committee was composed of the following gentlemen:

Mr. D. D. Dickson, Supervisor, Chairman; C. D. Buchanan, Village President, and ex-Congressman D. P. Richardson. This committee is about to submit its report, which will be appended hereto.

At Belmont, Scio, Wellsville and other adjacent points, serious and extensive damage was suffered by the destruction of crops, mill dams, bridges and roads, railroad bridges and embankments, and the washing away of soil.

Flood Prevention.— It is hardly necessary to state that with the short time and small amount of money available for surveys and examinations no extended investigation of the problem of flood prevention on the Genesee, nor, for that matter, on the other rivers of this division, has been possible. Fortunately, however, this subject has already been pretty thoroughly investigated and tangible results reached. Repeated and extended surveys and examinations of the subject of flood prevention and water storage on the Genesee have been made by the State during the past twelve years. The most extensive and final of these surveys was made by Mr. George W. Rafter of Rochester, a member of this commission, and the thoroughness with which this work has been done make it out of question to add anything to the detailed study, with the time and funds available. Mr. Rafter's report, submitted to the State Engineer and Surveyor on January 1, 1897, forms one of the exhibits to the Rochester Flood Committee's report mentioned above, and is herewith submitted with the report and the other exhibits. Mr. Rafter gives a list of the surveys and reports on this subject on page four of his report of 1897.

The plan finally recommended in the 1897 report to the State Engineer and Surveyor by Mr. Rafter contemplates the creation of a large storage reservoir holding 15,000,000,000 cubic feet of water, created by the building of a dam 100 feet high just above the upper Portage falls, forming an artificial lake 15 miles in length, at a cost of $2,600,000. This reservoir, it is estimated by Mr. Rafter, will not only prevent severe floods on the Genesee below its location, but also afford a total permanent continuous water power over and above the present low water power of the river of 50,000 gross horse power.

The Portage reservoir would not, of course, exercise any remedial effect on the river above its location; the prevention of floods in the upper portions must be accomplished by a combination of storage and channel regulation. The remedy at Angelica is clearly that of channel improvement, while on some of the other tributaries it is possible to secure sites for storage which shall take the peak off the floods on these tributaries.

The following table of rainfall, run-off, and evaporation for the Genesee river water-shed, as observed at Mt. Morris, has been abstracted from a series of observations furnished by Mr. George W. Rafter, a member of this Commission. From this table it will be seen that the mean annual run-off for the series of years covered by the observations, viz., 1890 to 1898, inclusive, was 14.2 inches of depth on the water-shed, while the lowest annual run-off observed during this period was 6.67 inches. This latter is, of course, the important figure in determining the amount which can be stored during the dryest year of this period. Longer periods might give somewhat smaller values for this minimum run-off.

TABLE IX.

GENESEE RAINFALL AND RUN-OFF.

Statistics of rainfall, run-off and evaporation at Mt. Morris from 1890 to 1898, inclusive.

Drainage area, 1,070 square miles.

Elevation above sea level, 565 feet.

In inches of depth on water-shed.

Water year begins on December first.

WATER YEAR.	Rainfall. Inches.	Run-off. Inches.	Evaporation. Inches.
1890.			
Storage season, December-May, inclusive	23.01	12.96	10.05
Growing season, June-August, inclusive	10.52	2.51	8.01
Replenishing season, Sept.-Nov., inclusive	14.01	5.75	8.26
Yearly total	47.54	21.22	26.32
1891.			
Storage season, December-May, inclusive	18.22	11.88	6.34
Growing season, June-August, inclusive	12.78	1.06	11.72
Replenishing season, Sept.-Nov., inclusive	7.12	1.11	6.01
Yearly total	38.12	14.05	24.07
1892.			
Storage season, December-May, inclusive	19.84	9.38	10.46
Growing season, June-August, inclusive	15.30	4.90	10.40
Replenishing season, Sept.-Nov., inclusive	6.55	1.14	5.41
Yearly total	41.69	15.42	26.27

TABLE IX — Continued.

WATER YEAR.	Rainfall. Inches.	Run-off. Inches.	Evaporation. Inches.
1893.			
Storage season, December-May, inclusive	20.65	11.10	9.55
Growing season, June-August, inclusive	9.55	1.00	8.55
Replenishing season, Sept.-Nov., inclusive	9.10	1.25	7.85
Yearly total	39.30	13.35	25.95
1894.			
Storage season, December-May, inclusive	27.71	15.73	11.98
Growing season, June-August, inclusive	7.95	1.46	6.49
Replenishing season, Sept.-Nov., inclusive	12.13	2.19	9.94
Yearly total	47.79	19.38	28.41
1895.			
Storage season, December-May, inclusive	13.20	5.63	7.57
Growing season, June-August, inclusive	11.13	0.36	10.77
Replenishing season, Sept.-Nov., inclusive	6.67	0.68	5.99
Yearly total	31.00	6.67	24.33
1896.			
Storage season, December-May, inclusive	17.84	9.25	8.59
Growing season, June-August, inclusive	10.28	0.83	9.45
Replenishing season, Sept.-Nov., inclusive	12.56	2.72	9.84
Yearly total	40.68	12.80	27.88
1897.			
Storage season, December-May, inclusive	15.68	7.31	8.37
Growing season, June-August, inclusive	11.92	1.34	10.58
Replenishing season, Sept.-Nov., inclusive	6.79	0.73	6.06
Yearly total	34.39	9.38	25.01
1898.			
Storage season, December-May, inclusive	18.66	10.40	8.26
Growing season, June-August, inclusive	14.15	2.05	12.10
Replenishing season, Sept.-Nov., inclusive	9.69	2.68	7.01
Yearly total	42.50	15.13	27.37
Mean.			
Storage season, December-May, inclusive	19.40	10.50	8.90
Growing season, June-August, inclusive	11.50	1.70	9.80
Replenishing season, Sept.-Nov., inclusive	9.40	2.00	7.40
Yearly total	40.30	14.20	26.01

CHEMUNG WATERSHED.

The drainage area of this watershed at the point where the Chemung enters Pennsylvania near Waverly amounts to 2,550 square miles, of which 700 square miles of the drainage area of the Tioga, a tributary of the Chemung, lies in Pennsylvania. With this watershed, though not strictly belonging to it, there is also considered the watershed of the Cayuga creek, a stream which enters the Susquehanna just over the Pennsylvania state line. The area of this watershed is about 160 square miles and is not included in the drainage area of the Chemung, given above.

The Chemung river is formed by the confluence of the Cohocton and Tioga rivers at Painted Post, and the Tioga river receives at Erwin, just above Painted Post, the Canisteo river, which is its chief tributary. The following table gives the principal tributaries of the Chemung river and their respective drainage areas:

TABLE X.

STREAMS TRIBUTARY TO CHEMUNG RIVER.

Tributary.	Drainage Area — Sq. M.
Cohocton river	580
Canisteo river	570
Tioga river	830
Seeley creek	65
Post creek	40
Newton creek	80
Cayuta creek (Susquehanna river)	170

The Chemung river itself, as well as the Cohocton and Canisteo rivers, are alluvial streams nearly to their headwaters, while the Tioga is torrential for the greater portion of its length. The topography of this watershed may all be classed as hilly or mountainous. The parts remote from the main streams are roughly rolling, while in the vicinity of the main streams the topography is much more rugged and the alluvial valleys are flanked abruptly by high and steep hills, precipitous and almost bluff-like at their

base. The main valleys are at elevations reaching from 800 to 1,200 feet above sea level, while the hills which flank these reach an altitude of 2,500 feet. The streams tributary to the main rivers are all torrential, and many of them have convex profiles. Their run-off, accordingly, is very great at times of storm, but very slight during other periods. Except in the valleys the soil would not be classed as fertile, though a considerable portion of the hill country is cultivated. Large portions, however, are also in second growth timber and brush. The estimated percentage of forest land is 20 per cent., which does not include, however, considerable areas abandoned to brush.

The localities at which flood conditions on this watershed are most severe are Hornellsville, Canisteo, Addison, Bath, Corning and Elmira, though many other localities suffer from floods to a less extent.

Hornellsville and Canisteo.— The Canisteo river rises in the town of Birdsall, fifteen miles northwest from Hornellsville, and is torrential in its nature for the first ten miles, to Arkport. At this point the alluvial compartment begins, which is maintained for the entire remaining portion. The valley, in the main, is broad, varying from 1,000 to 4,000 feet in width; the surface very regular and level, and the soil usually a clay loam overlying several feet of impervious clay, under which water-bearing sand and gravel occur down to the bed of the original erosion. The river receives as its principal tributaries the Canacadea creek at Hornellsville, Bennett creek and Stevens creek at Canisteo, and Tuscarora creek at Addison. These tributaries, with their steep grades and frequently convex profiles, bring large amounts of detritus to the bed of the river. The effect of the accumulation of this material at the junction of these torrential tributaries has been to produce barriers which cause the river to occupy a series of successive pools and riffles. The city of Hornellsville, the village of Canisteo, and the village of Addison are themselves each located in part on ground which has been slightly raised above the ordinary flood plane of the river by past accumulations of flood detritus brought down by the Canacadea creek, Bennett and Purdy creeks, and Tuscarora creek, respectively, and the flood

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material brought down by these tributary streams has in each instance produced bars and obstructions in the river channel which have caused the river slope immediately above these obstructions to be flattened, while the river slopes immediately below these points are steepened and have ample velocities. As the average fall of the river from Arkport to Hornellsville is only ten feet per mile, and from Hornellsville to Painted Post only five feet per mile, it will readily be seen that comparatively small amounts of obstructive material will cause very appreciable changes in the resulting river slope.

To illustrate the effect of the torrential tributaries in flattening river slopes just above their confluence, it may be cited that the fall of the Canisteo river for two miles just above the mouth of Canacadea creek is two feet per mile, while for the same distance below the mouth the fall is eight feet per mile. Similarly, the fall of the river for the two miles just above the mouth of Bennett and Stevens creeks is three and one-half feet per mile while it is ten feet per mile for the two miles just below these mouths. A river channel of a certain size will discharge or carry off only one-half as much water per second if its slope is two feet per mile as it would if it were eight feet per mile, and if the channel is just full with a slope of eight feet per mile it will overflow when the slope becomes flatter, and for a slope of two feet per mile the given channel would carry but one-half of the water to be taken away and the overflowed valley would have to carry the other one-half.

This flattening of slope just above torrential tributaries thus comprises one cause leading to the occurrence of floods; another cause originates in the fact that the valley formation being alluvial in character, readily eroded when not protected by the roots of trees and brush, the river channel, through the agency of persistent tendency to erode its concave bank, has assumed a very tortuous location, with resulting increase of length and further flattening of slope, and a corresponding reduction of velocity. Channel cross sections, therefore, which were just ample to carry the flood discharge without overflow when the channel was straight, are now, with the diminished velocity, insufficient, and

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as a result the river overflows its banks. At times of such overflow the general direction of the moving flood coincides with the general direction of the valley which thus at many points runs across the direction of the channel. Wherever the direction of the general flood surface is strongly oblique to that of the water following the channel an appreciable loss of energy occurs, with a resulting reduction of velocity and a deposit of coarser material. Such deposits occur, if at all, on the up-valley bank of the channel, which, being in the main the convex bank and hence the one protected from erosion, gradually encroaches on the channel. This narrowing of channel is still further augmented by the growth of shrubbery along the steep banks, just above the low water line, which not only catch floating material, but, by their effect in checking the velocity of moving water along the banks still further encourage the deposit of silt on the banks.

The general elevation of the alluvial banks or flood plane of the river above ordinary low water is about five or six feet, while the surface of the river at floods extends from one to four feet above this point. As in all alluvial valleys subject to overflow, the immediate banks of the river are higher than the surface of the valley back from the stream. In the Canisteo river this transverse slope of the flood plane varies from three to nine feet per mile, so that the depth of overflow is less on the immediate banks of the river than farther back from the channel.

The Canacadea bar, together with some other local obstructions at Hornellsville, cause the river to overflow its banks for nearly the whole width of the alluvial valley just above Hornellsville, and the smaller obstructions at the mouth of Bennett creek and Stevens creek here also cause the river at flood time to occupy nearly the whole of the alluvial width. While considerable portions of the level parts of both Hornellsville and Canisteo are kept above the flood surface by being on the flat mound of detritus brought by the Canacadea creek and by Bennett and Purdy creeks, respectively, the growth of both of these towns has extended their built-up portions into the flooded districts, so that many blocks and streets are annually inundated, and large areas of both of these towns that are above flood levels suffer from the

flooding of cellars, with corresponding serious impairment to sanitary conditions as well as direct material damage.

From the examination of the local conditions by the two commissioners assigned to this division, it appeared probable that the prevention of floods was feasible through stream regulation; but it was not possible to state this with certainty without surveys. Accordingly the commissioners recommended to the local committees which had been appointed at Hornellsville and Canisteo, respectively, that such surveys be made, and guaranteed to furnish a portion of the expense of such surveys. The Erie Railway Company, which had been a severe sufferer from floods from above Hornellsville to below Canisteo, also offered to contribute a portion of the expense, and the surveys were made under the direction of the commissioners, and the hydrograpphic maps showing the result of these surveys are appended hereto as one of the exhibits. From the result of these surveys it is possible to state definitely that the matter of flood prevention at both Hornellsville and Canisteo is one that is feasible, and one whose cost would be amply warranted by the resulting benefits.

Water storage as a means of flood prevention is out of the question in these instances, as it is for all of the places on this watershed, since reservoir sites are not financially available. Dependence must be placed, therefore, entirely on stream regulation. It should be understood that there are but two general methods of preventing floods at any particular point; first, the prevention of the flood waters from reaching the point fast enough to cause a flood; or, second, the leading of the waters away from the point fast enough to prevent their accumulation. The former plan includes the artificial detention of waters by reservoirs, or their natural detention by forestation. Natural lakes and ponds, and even marshy area, have decidedly conserving tendencies toward natural flood prevention. The second method secures the more rapid carrying away of waters by either increasing the velocity of the current or increasing the cross section of the channel of the streams, or both conjointly.

In the present instance of Hornellsville and Canisteo, a study of the results of the surveys shows that it will be possible to

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increase current velocities somewhat by straightening the more abrupt irregularities of the channel location, but that this in itself cannot be carried far enough to alone furnish the needed remedy on account of the danger of abnormal bank erosion from too high stream velocities. The remaining portion of the remedy must be accomplished by increasing the cross section of the channel.

There is good reason to believe that the very friable and erodible nature of the bank material which renders high velocities unsafe, may be taken advantage of in the execution of any future channel improvements by doing the needed excavation work by means of suction dredges which are available for use in such material as the test pits on the Canisteo section show to exist there, and such as probably also exists on the Hornellsville section.

Whatever the method employed for carrying out improvements, and especially whatever the general plan adopted for flood prevention, it is essential to understand that these two sections of the river are to a large degree tied up with one another, and the plan adopted for one must be in thorough harmony and consistent with the other. Independence of action on these two sections would quite likely lead to discordant results.

The personnel of the two local committees were as follows: The Hornellsville flood committee comprised Hon. E. J. Nelson, Chairman; Hon. I. W. Near, Hon. Russell M. Tuttle, Mr. David Woolever and Hon. Milo Acker.

The Canisteo flood committee comprised Hon. Eli Soule, Chairman; Village President James A. Almy and Mr. John H. Consalus. The death of Mr. Soule during the progress of the work of the committee caused a vacancy, which was filled by the appointment of Hon. A. M. Burrell, who was also made chairman of the committee. The reports of these respective committees are appended hereto as exhibits.

Addison.— To a great extent the same physical conditions prevail here as at Hornellsville and Canisteo though the valley at Addison is much narrower, and the extent of territory flooded by the river is very much less. The harmful results here are due,

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in the main, to the tendency of Tuscarora creek to break out of its banks and form new channels. This creek, being a torrential stream, has in the past brought down large quantities of torrential detritus, and the rising of its bed has progressed accordingly. Minor local causes are sufficient to disturb its equilibrium and to cause it to readily change its channel. During the flood of July, 1902, the larger portion of the volume of water of the stream flowed through the residential portion of the town, with considerable damage to property and the production of unsanitary conditions following the flood. The regulation and control of the channel of Tuscarora creek appears to be a feasible matter, but further surveys and more detailed examinations will be necessary before anything definite can be stated as to the most proper method or as to the results to be expected. The Addison flood committee, whose report is appended hereto, comprised the following gentlemen: Messrs. L. B. Aldridge, F. H. Wheaton and John Hinman.

Corning.— The city of Corning has suffered seriously in past years from inundations by floods in the Chemung, but has recently undertaken and carried out a system of improvements which thus far have succeeded in entirely preventing these inundations. The city is situated on the Chemung river about two miles below the junction of the Tioga and Cohocton, and a large portion of the city is built directly on the flood plane of the valley. At this point the river flows near the southern edge of the valley, and the greater portion of the city lies on this narrow alluvial strip and extends up on to the abrupt hill which flanks the valley on the south. The greater part of the inundations occurred on the northern side of the river, though those which occurred on the south side were more severe in their results, owing to the denser population there. In 1892 an act was passed by the Legislature creating a board of river commissioners and giving them authority to carry out the needed improvements, and to issue bonds for the purpose. Later the act was amended extending the authority to issue bonds to $150,000. The work of improvement was commenced in 1896 and completed in the fall of 1897. The general plan followed was the enlargement of

the river channel through and below the city and the raising of the banks by artificial dikes. The minimum cross section allowed through the bridges was 10,500 square feet. The dikes have a total length of four and nine-tenths miles and vary in height from four to nineteen feet. These dikes not only extend along the river fronts opposite the city and for a considerable distance down stream, but they also extend for nearly two miles along the westerly bank of Post creek, a torrential tributary reaching the river from the north just below the city. Seven streams and a number of surface water drains are provided for in different ways; four were carried in closed conduits which extended above highwater mark on the land side; others were carried through the dike by leaded cast iron pipes with gate valves, and also with automatic flap valves at the river end. The work, in aggregate, included the extending of two highway bridges, the raising of a railroad bridge, the building of 1,200 feet of retaining wall, 25,000 lineal feet of dike, amounting to 330,000 cubic yards of material moved, and the drainage culverts above mentioned. During the construction of most of the work of improvement the commission comprised Messrs. Frank D. Kingsbury, President; Harry C. Heermans, Stephen T. Hayt, Jr., Oscar W. Bump, John B. McMurney and Benjamin W. Wellington. The designing and constructing engineer was Mr. Palmer C. Ricketts, Mem. Am. Soc. C. E. of Troy, N. Y., and Messrs. W. W. Rosseau and C. E. Curtis, assistant engineers

The river improvement described above, which was inaugurated and carried out as a city measure, did not include a stretch of the south bank of the river in front of the easterly portion of the city, which was then protected by an embankment and slope wall about 4,000 feet in length built years before by the State of New York. This embankment and slope wall has deteriorated, so that a portion of the river front protected by this embankment is now the weak link in the city's protection from floods. During the floods of 1902 the water was with great difficulty kept from coming over this old embankment. In the past the State has appropriated funds for the maintenance of this embankment and slope wall, and it is held by the local authorities that the

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burden of maintaining this protection rests with the State. Without attempting to investigate the validity of this claim, it is nevertheless very evident that if the city is to enjoy the benefits of the extensive and costly improvements recently completed, this intervening stretch of river front will have to be put into effective condition either by the city or the State. With the proper repairs made on the State embankment and slope wall, which would not be a matter of heavy expense, the city's protection against all ordinary floods would seem to be very complete.

Elmira.— The city of Elmira lies on the Chemung river about twenty-five miles above its confluence with the Susquehanna in Pennsylvania. The city lies in a broad, level valley, extending at this point nearly north and south, doubtless occupied in some past geological period by a large lake of which Seneca lake is the only remnant. A large portion of the city is on the level flood plane of the valley, while other parts are on lacustrine terraces flanking the main valley on the west. The Chemung river does not reach the city through this main valley, but approaches it from the west through a chasm which has been cut through the hills lying west of the city, and its own valley is therefore not as broad as the abandoned main valley, hardly exceeding a half a mile in width at any point near the city. One of the tributaries of the river, Newton creek, flows along the easterly side of the main valley at the easterly limit of the city. Another tributary, Seeley creek, joins the river about two miles southeast of the city.

The most severe flood which has occurred at Elmira in recent time is that of June 1, 1889. Following this flood, the city authorities engaged Mr. Francis Collingwood, Mem. Am. Soc. C. E. to make a survey and investigation of the cause of floods and the necessary remedies, and Mr. Collingwood submitted, on February 12, 1890, his report of his investigations together with a map of the river and with the flood profile for the June 1, 1889, flood. Mr. Leon Conkling, City Engineer of Elmira, has furnished the commission with Mr. Collingwood's map and with a tracing of the flood profile above referred to. An examination of this profile shows that local obstructions to flood flow are caused

by a dam extending across the river near the westerly city line and by several bridges spanning the river below this dam. In addition to these specific obstructions the general condition of the channel through the city is unfavorable to a free flood discharge. The general character of the river channel near the city is characterized by breadth and shallowness, with abrupt changes of width and depth. This has evidently been brought about by the fact that the river reaches the vicinity of Elmira after having passed through the gorge in the western hills with a high velocity, due to the rapid descent through the gorge. The river, therefore, approaches the city loaded with sediment and moving large amounts of detritus along its bed. On reaching the more level portions this velocity is checked, and the stream is no longer able to move the detritus, which is therefore left in the channel and gradually accumulates with each successive flood. The shoaling of channel due to such accumulation of coarse material encourages the erosion of the softer banks, thus resulting in a tendency to shallowing and broadening the channel. This result is accumulative, for the broad, shallow channel tends to still further diminish flood velocity and to cause a stoppage of rolling detritus and the deposit of the coarser suspended material. As a result of this retardation of velocity and consequent increase of water cross-section, the river overflows its banks and inundates large portions of the city, doing great damage in the way of inundation of houses and grounds, the filling of cellars and injury to property, and interruption to all business and travel, beside the very serious results of a sanitary nature. During the 1889 flood the river reached a height of fourteen feet above low water at certain points, and a number of other floods have approached this in severity. During March, 1902, nearly 1,300 acres of territory within the business and residential portions of the city were inundated, and City Engineer Conkling estimates the damage within the city of Elmira from this flood to have been $155,000.

After a careful study of the conditions as developed by his survey Mr. Collingwood prepared four alternate plans for flood prevention, differing in the extent of protection to be secured and

in the permanence and character of the improvement. These plans were estimated to cost from $150,000 to $2,400,000. There appears to be no good reason why Elmira may not secure flood protection of whatever extent the city is willing to pay for; since the hydraulic problem, while a somewhat complicated one, presents no insurmountable engineering difficulties but simply those of financial considerations.

Flood Damages to Railroads.— The valley of the Chemung river, and of its three river tributaries — the Tioga, Canisteo and Cohocton — are all traversed by lines of railway. These are the Erie Railway, Delaware, Lackawanna and Western Railway, the Lehigh Valley Railway and the Fall Brook Division of the New York Central Railway. The lateral tributaries of all these rivers are of the most pronounced torrential type. For the most of them their beds are dry during a considerable portion of the year, but rushing torrents after rain storms. They bring down to the alluvial valleys immense quantities of sand, gravel, shingle, cobbles, and even boulders. The movement of this material is stopped as soon as the torrential stream slope flattens on reaching the edge of the valley, with the result that the channels and waterways for the stream are suddenly filled with this coarse transported material, forcing the water to flow over the top of it, or, as is generally the case, to force a new channel for itself down the surface of the flat cone which has been formed at the mouth of each of these lateral gorges. The damage arising from these sudden accumulations of transported material and the outbreak of the streams from their normal channels, while serious to the land over which the water passes, is even more disastrous to the railways which these lateral streams cross. The destruction of track and bridges and the burying of track under deposits of gravel and cobbles is still further aggravated by the serious interruption to traffic, and the railroads have accordingly been among the worst sufferers from these torrential floods. The injury to railroads at their crossings of these lateral torrential tributaries is one of frequent occurrence and very general, occurring not only at numerous points along the Chemung and its

tributaries, but also along the Genesee and its tributaries and the Allegany.

The proper consideration of the floods on these torrential streams demands quite different investigations, and requires entirely different remedies from the alluvial rivers and streams. The great number of these tributaries, and the diversity of their conditions has precluded within the short time available for this investigation any systematic study of torrential floods and their treatment. It is important to understand, however, that since the torrential deposits at the mouth of these tributaries have played an imporant part in the causation of floods in the alluvial valleys, and in fact have helped to make the alluvial valleys what they are, the proper and comprehensive study of alluvial flood improvements must comprise, as an important part, the study of torrential floods and their prevention or amelioration; at least so far as to control the transportation of mountain detritus. In France and in Italy considerable attention has been given to the study of the control of torrents, but in most instances under conditions of climate, topography and soil formation so different from what prevails in western and southern New York as to render the methods and results obtained abroad not directly adaptable to New York conditions.

ALLEGANY WATERSHED.

The Allegany river rises in McKean and Potter counties. Pennsylvania, enters New York State near the boundary between Allegany and Cattaraugus counties, flows thence northwesterly to Salamanca about thirty miles, thence southwesterly for twenty miles, crossing the Pennsylvania line again near the western boundary of Cattaraugus county. The total drainage area of the Allegany and its tributaries at its point of leaving New York State is about 2,300 square miles. The drainage area at this same point within the State of New York is about 1,330 square miles. The drainage area of Conewango creek, a tributary of the Allegany river but which does not join the river until after it crosses into Pennsylvania, is 770 square miles at its point of leaving New York State, making the total area of

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Allegany watershed lying within New York State 2,100 square miles. The principal tributaries of the Allegany in New York, with their total drainage areas, are as follows:

TABLE XI.

PRINCIPAL TRIBUTARIES OF ALLEGANY RIVER IN NEW YORK.

LEFT BANK.		RIGHT BANK.	
Tributary.	Drainage area—square miles.	Tributary.	Drainage area—square miles.
Tunaunguant creek*.....	*100	Olean creek.....	180
Tunaunguant creek†.....	†32	Five Mile run.....	40
Big Red House.....	36	Great Valley creek.....	145
Quaker creek.....	25	Little Valley creek.....	42
		Conewango creek (at Pennsylvania line).....	770

The topography of this entire watershed is rugged, and certain parts of it very rough. With the exception of minor portions of the Allegany river itself and some of its main tributaries, the stream slopes are all strong, and flooded districts are not extensive.

Floods at Olean.—The Allegany river, in this region, flows through a rather narrow alluvial valley flanked by abrupt hills.

The slope of the stream is light; the fall from the point where the river enters New York State to Olean, a distance of 9 miles, is only 10 feet, and the fall for the 24 miles from Olean down to Salamanca is 50 feet. The slope is therefore only about a foot per mile for the 9 miles east of Olean, and 2 feet per mile from Olean to Salamanca. This flattening of slope is doubtless due to the deposit of transported material from Olean creek, which reaches the river at Olean.

Extremely severe floods at Olean are not of very frequent occurrence, but when the ordinary flood height is exceeded, which occasionally occurs, the results are rather severe.

Floods at Olean come from both the river and Olean creek. Olean creek being a more nearly torrential stream, though rather flat in the portion immediately above Olean, its flood waves reach

*In Pennsylvania. †In New York.

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Olean before those from the river, and for storms of short duration the Olean creek high water subsides before the Allegany river high water reaches this point. For long storms, however, this is not the case.

The local flood committee at Olean comprised the following gentlemen: Mr. David E. Barrows, Mr. J. F. Johnson, Mr. E. E. Allen and Mr. Fred L. Eaton.

From information received from City Engineer E. E. Allen, of the above committee, the following flood statistics concerning the flood of March 2, 1902, are drawn:

Area of city territory inundated	190 acres.
Population of flooded district	1,200 to 1,600
Number of houses in flooded district	280
Direct damage from floods, not including incidental damages	$4,000 to $6,000

Floods which occurred in the years 1889 and 1892 were from two to three feet higher than the flood of March, 1902.

Photographs of some flooded points in Olean are given in the supplement to this report, and it may be interesting to notice from one of these photographs that the owner of one of the residences shown has protected his house from injury from flood drift and ice by a line of heavy piling in his front yard extending as high as the second story windows with a heavy timber boom chained to the piling.

Conewango Creek.— The Allegany tributary which is entitled to chief consideration in this inquiry is the Conewango creek, which includes the flow from Chautauqua lake. This creek rises in Perrysburg, Cattaraugus county, and in Hanover, Chautauqua county, and flows southerly, following generally the county line to the town of Conewango, thence southwesterly, receiving the Chautauqua lake drainage through the Chautauqua outlet in the southern part of the town of Poland, crossing the New York-Pennsylvania line at Fentonville.

While the territory drained by the stream is in general hilly and rolling, the northern portion of the stream has a very flat descent and its valley is accordingly swampy. For the sixteen miles from Markham in the town of Dayton, to the mouth of

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Clear creek in the town of Conewango, the fall is only twenty-five feet in the valley, and, as the channel alignment is quite irregular, the actual stream slope is considerably less than this and probably less than one foot per mile. This stretch represents the main portion of Conewango swamp, which lies in the towns of Villanova, Cherry Creek, and Ellington in Chautauqua county, and in the towns of Dayton, Leon, Conewango and Randolph in Cattaraugus county. The swamp has a width varying from one-half mile to three miles, and averages about one mile in width, though the total width of the valley subject to overflow will average about three miles. This swamp furnishes another instance of the interruption to the hydrography and topography of a valley by the inflow of detritus from tributary streams; the transportation and deposit of detritus from Little Conewango creek, which enters the main stream in the southern part of the town of Conewango, has in time past raised the bed of the main stream at this point and flattened the slope of the valley to an extent so great as to have produced the marshy conditions now existing.

In a report on the Conewango swamp made by Prof. C. C. Brown to the State Board of Health on December 1, 1901, the areas of land actually in swamp and those subject simply to overflow are as follows:

ACREAGE OF CONEWANGO SWAMP.

County.	Swamp land. Acres.	Overflowed land. Acres.
Chautauqua	3,280	10,250
Cattaraugus	8,750	21,114
Total	12,030	31,364

The drainage area down to the outlet of the swamp is:

County.	Square miles.	Acres.
Chautauqua county	106	68,180
Cattaraugus county	157½	100,819
Total	263½	168,999

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Several years ago the channel of the creek through Conewango swamp in the towns of Villanova, Cherry Creek and Ellington in Chautauqua county, and in Leon in Cattaraugus county, was improved for the purpose of reclaiming these portions of the swamp, at the expense of the towns through which the improvements extended. There seems to be some uncertainty as to the efficiency of these improvements in securing the necessary drainage of the land; but the work resulted in the spring floods leaving the swamp so much more rapidly as to flood and inundate lower portions of the creek valley, especially for the fifteen miles between Kennedy and the State line. To correct these defects the Legislature, in 1900, passed an appropriation of $35,000 for the purpose of improving the stream channel in the portion of the valley thus affected. The bill provided that the plans should be provided by the State Engineer, and that the work should be prosecuted by contract under the direction of a commission to be appointed by the county judge. Mr. F. P. Cobham was appointed commissioner, and Mr. Mark W. Howard, auditor. The work of improvement comprised the straightening of the more tortuous portions of the stream alignment, the removal of driftwood jams and tree trunks, and the removal of gravel bars at the mouths of tributary creeks.

In the report to the State Board of Health above referred to Professor Brown submitted the results of his very thorough study of the hydrology of the swamp and his proposed plans for the main features of its improvement. Very properly, he recommended that the work be commenced at the outlet and pushed upstream as far and as rapidly as should be deemed necessary.

In summing up his report Professor Brown says:

"It may be said in summing up that it is desirable and entirely feasible to make the improvement of the channel of Conewango creek desired, and to protect the new channel by changing the course of Davis brook. The drainage of the swamp to any desired extent is only a question of deepening the outlet and straightening and reducing to the average gradient the

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slope of the channel, increasing its cross section in the lower portions, this improvement, to secure the fullest effect, to be carried the entire length of the swamp. A very material benefit can be obtained without carrying the work more than three or four miles up from the outlet, leaving the further prosecution of the work to individual effort. The expense of the improvement will not be excessive, and will be more than repaid by the increased valuation of the lands benefited. The expense will be fully justified by the increased healthfulness of the region thus delivered from the malevolent influence of the decaying vegetation and the noxious vapors of the swamp."

LAKE ERIE AND NIAGARA WATERSHED.

The drainage area of this district comprises a territory of about 2,250 square miles. The principal streams are as follows:

TABLE XII.

STREAMS TRIBUTARY TO LAKE ERIE AND NIAGARA RIVER.

Tributary.	Drainage area.
Cayuga creek, Buffalo river, Cazenovia creek	420
Smoke creek	25
Big Sister creek	50
Muddy	15
Cattaraugus creek	560
Walnut creek, Silver creek	60
Canadaway creek	35
Chautauqua creek	32
Tonawanda creek, Ellicott creek	610

With the exception of the headwaters of the Cattaraugus creek and the Tonawanda creek, which are in hilly country, the topography is level or gently rolling and the stream-slopes are comparatively flat. The three streams on which flood conditions demand consideration here are Cattaraugus creek, Buffalo river and Tonawanda creek. For a considerable portion of the length of these creeks their slopes are so flat and the adjacent country so level that the lands are frequently inundated, and

in places for a considerable portion of the year. These lands are many of them of high fertility, and their reclamation by proper stream regulation is not only a feasible but a very desirable matter both on economic as well as sanitary grounds.

Tonawanda Creek.— This stream rises in the west-central part of Wyoming county, flows northerly through Attica to Batavia thence westerly to the Niagara river at Tonawanda, at which point it joins its chief tributary, Ellicott creek. The drainage area of this stream, including that of Ellicott creek, is 610 square miles. For the first thirty miles of its flow to Batavia, the creek drains hilly and rolling country and has for the greater part of this section a strong descent. From Batavia to Tonawanda, a distance of nearly sixty miles as the stream flows, the topography is very flat, the total fall between these two points being only about 310 feet. Along this latter portion of the stream its drainage area is not only very flat and marshy but it is also narrow.

Between Batavia and its mouth the Tonawanda creek has been modified by two artificial interruptions: First, by the diversion of a portion of its waters through a diversion canal into Oak Orchard creek, from which water is drawn into the Erie canal at Medina; second, at Tonawanda the creek is artificially raised by a State dam and the stream canalized and used as a part of the Erie canal as far as Pendleton, a distance of twelve miles from Tonawanda. And the major portion of the water supply of the western division of the Erie canal is drawn from Lake Erie through the Erie canal and through this canalized portion of Tonawanda creek.

The dam diverting water into the Oak Orchard feeder is about one-half miles east of the west line of Genesee county. From the point where the Tonawanda creek crosses this western boundary of Genesee county the creek is the boundary between Erie and Niagara counties. The fall in the creek from Batavia to the top of the Oak Orchard diversion dam is about 260 feet, giving a slope of thirteen feet per mile. From the foot of the Oak Orchard diversion dam to Pendleton, the point where the Erie canal enters Tonawanda creek, the fall is about forty-five

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feet, giving a slope of one and one-half feet per mile. On this portion of the stream the channel alignment is extremely sinuous, the total length of the stream channel between the Oak Orchard diversion dam and the canal at Pendleton being twenty-nine miles, while the direct distance is only fifteen miles. With this very flat slope it is not surprising that portions of the land immediately adjacent to the creek are marshy and that extensive areas are annually inundated. This marshy portion of the stream will be considered in connection with the Oak Orchard swamp, a tributary to Lake Ontario.

Floods at Tonawanda.— The state dam at Tonawanda, built for the purpose of canalizing the creek from Tonawanda to Pendleton, is situated below the confluence of Ellicotte creek, so that this dam artificially raises the water in both Tonawanda and Ellicotte creek.

The dam is 270 feet long and its permanent crest is forty-two inches higher than mean level of water in Niagara river just below the dam, and folding flash boards raise the water sixteen inches higher. Exceptionally high floods have occurred here in 1865, 1889, 1896 and 1902; none of the latter floods exceeding in height the flood of 1865, though the flood of March 30, 1896, was very nearly as high. During this flood the water flowed over the permanent crest, with flash boards down with a head of fifty-eight and one-fourth inches, indicating a discharge over the dam of 9,600 cubic feet per second and a height of flood level of eight feet four inches above the mean level of water in Niagara river.

The water passing over the dam did not represent the full discharge of the creek at that flood. At the same time there was a head of three feet of water flowing over sixty feet waste weir from the canal directly into the river, representing a discharge of about 1,000 cubic feet per second, making the total discharge of the creek at Tonawanda 10,600 cubic feet per second. So far as could be learned from Canal Foreman Christopher Swinger, no water was passing toward Buffalo beyond this waste weir. If this is the case the above discharge represents the entire flow of Tonawanda and Ellicotte creeks at the time of the 1896 flood, and gives a flood discharge of about eighteen cubic feet per

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second per square mile. This low value of the flood discharge is evidently due to the natural storage or detention in the overflooded and swampy portions of the creek valley west of the Oak Orchard diversion dam and also to the diversion of some of its waters to the Oak Orchard creek and swamp during this flood.

This flooding of the creek to a height of nearly five feet above its ordinary artificial level as produced by the State dam or over eight feet above its original level before the dam was built causes the inundation of immense areas of land between Tonawanda and Batavia. Mr. Henry Carney, of Tonawanda, estimates that the ordinary high floods, such as occur every two or three years, inundate not less than 500 acres within the city of Tonawanda, a large portion of which is residential territory.

Buffalo River.—Buffalo river is formed by the confluence of Cayuga creek, Buffalo river and Cazenovia creek, which unite near Buffalo.

The streams all have their source near and just west of the headwaters of Tonawanda creek, Cayuga creek and Buffalo river, rising in Western Wyoming county, while Cazenovia rises just west in Erie county. The Cayuga flows northerly and thence westerly paralleling very closely the Tonawanda creek. Buffalo river and Cazenovia creek flow northwesterly to their confluence at Buffalo. The drainage area of these three streams conjointly at the mouth of Buffalo river is 420 square miles.

The topography at the headwaters of these streams is rugged; for the middle portions slightly hilly and rolling; and for the latter portions very gently rolling and flat. The slope of Cazenovia creek undergoes less flattening in its lower reaches than occurs in Buffalo river and Cayuga creek with the result that flood crests in the Cazenovia reach Buffalo from three to six hours earlier than those in Buffalo river and Cayuga creek. The stream alignment in the lower portions of these streams is very irregular and sinuous, which fact in conjunction with the decided flattening of the stream slopes from source to mouth brings about the usual congestion of waters at flood time in the lower reaches of the streams. While these conditions cause the inundation of large areas of agricultural lands, the most serious injury

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from floods is suffered by city and suburban property in and adjacent to Buffalo. The annual occurrence of floods in the Buffalo river and its two tributaries has long been a source of recurring damage within the city of Buffalo and has been a serious bar to the development of the city in the southeast direction and hence a source of heavy depreciation of possible city and suburban land values. The engineering department of the city of Buffalo has for several years past been making hydrographic studies of these streams and their floods, with a view to the devising of plans for flood prevention.

This work has been followed with increased activity during the last year or two, so that there now exists a large amount of valuable information available for use in the consideration of the most feasible plans for flood prevention and in the elaboration of such plans.

The public consideration of the question of flood abatement in South Buffalo has been encouraged and aided by a local organization, known as the Buffalo River Improvement Association, of which Mr. A. J. Elias is president, Mr. C. H. McLaughlin is vice-president, and Mr. Frank F. Williams is secretary and treasurer; the office of the association being at 118 Erie County Bank building, Buffalo.

Immediately after the first inspection by the commissioners assigned to the western division, the following local gentlemen were appointed to comprise the Buffalo Flood Commission:

Hon. Erastus C. Knight, Mayor, Chairman.
Colonel Francis G. Ward, City Commissioner of Public Works.
Mr. C. M. Morse, Deputy Engineer Commissioner.
Mr. George H. Norton, Assistant Engineer Commissioner.
Mr. A. J. Elias.
Mr. C. A. McLaughlin.
Mr. Frank F. Williams.

This committee has submitted a report on the subject of the Buffalo river floods, going particularly into the hydrography of the streams and has accompanied their report by the following exhibits:

1. A map showing the over-flowed territory in the city of Buffalo.

2. Map of the water-sheds of the Buffalo river, Cayuga creek and Cazenovia creek in Erie and Wyoming counties.

3. Profile of flood heights at numerous points along the Buffalo river within the city of Buffalo during floods of the following dates:

January 5, 1890.
December 16, 1893.
January 14, 1894.
May 20, 1894.
March 30, 1896.
January 13, 1898.
February 16, 1898.
December 5, 1898.
December 22, 1898.
January 13, 1900.
February 9, 1900.
April 22, 1901.
December 14, 1901.
March 1, 1902.
July 7, 1902.

Together with a profile of the river bottom between the W. N. Y. & Penn. R. R. bridge and the end of the North pier.

4. Profile of flood heights at four points on Cazenovia creek within the city of Buffalo between Cazenovia street and Bailey avenue.

5. Flood hydrographs for the Buffalo river and Cazenovia creek for the flood of March 1, 1902, at:

Cazenovia street,
South Ogden street,
Stevenson street,
Seneca street,
Abbot road,
Farmers Point,
Hamburg street,
Ohio street,
Michigan street,
Main street,
North pier.

6. Table of numerical elevations of flood heights in the Buffalo river and Cazenovia creek for each of the floods enumerated under item No. 3 above for each of the observation stations from South Ogden street to the end of North pier, and from Cazenovia street to Bailey avenue.

7. Curves of probably maximum discharge based on a discharge of 23,000 feet per second at 10 a. m., Saturday, March 1, 1902.

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8. Back-water curve for varying heights of water at the lake outlet or for artificial obstructions.

9. Curves of discharge and elevation of surface above proposed regulating weir on Buffalo river near city line (preliminary study).

The report of the Buffalo flood committee, with its exhibits, will be found as a supplement to this report.

The report of the committee states that the area of the city property flooded amounts to 1,600 acres and incloses a population of about 10,000 people. The assessed valuation of the flooded area is about $5,000,000. The maximum flood discharge of the combined streams as reported by the committee is about 23,000 cubic feet per second, or about 54 cubic feet per second per square mile of drainage area.

Deputy Commissioner of Public Works C. M. Morse states that a conservative estimate of the money damage to public and private property in the city of Buffalo from the floods of 1902 would aggregate $34,000, and he appraises the enhancement of city values from the proposed flood improvement at $2,000,000. The proposed scheme of flood improvement comprises a system of stream regulation by which the flood profiles within the city are to be lowered within bank limits, but are to be left unchanged in the sections of the streams above the city by regulating weirs. The lowering within the city is to be accomplished by both increase of velocity and increase of cross-section; the former by removing obstructions and cutting off bends, the latter by deepening and widening the channel. The retention of the present conditions in the reaches above the city is considered by the Buffalo engineers to be essential in order that excessive erosion and transportation of silt may not destroy the effect of the new improvements within the city. Looked at from the standpoint of Buffalo alone, this plan would be proper, and the city clearly has a right to make its own improvements and to take steps to confine the benefits to its own boundaries, particularly if such confinement is necessary to maintain the full effect of the improvements. It would be possible to effect such improvements and to apply such safeguards in the upper

portions of the streams immediately contiguous to the city as to secure to those parts of the stream also the benefits of the improvements within the city, and without endangering the permanency of the city channel improvements, but the city is not in position to go out into the country districts and carry out such improvements as would secure these results, for it has neither the authority to do so nor would it be warranted in making expenditures for this purpose even had it the right to do work on the stream outside the city limits. Clearly it is desirable that as large a section as possible of the streams concerned should enjoy the benefits of any improvements made, and it is not desirable that want of jurisdiction and want of an equitable means of assessment should stand in the way of securing the maximum benefits attainable. This would appear to be a case where some central authority, having both power to plan and carry out the desired improvements without regard to municipal boundaries, and the authority to assess the burden of cost on the beneficiaries, whether State, city, town, or private interests, would obtain results greatly in excess of those now available under restriction of municipal authority. Fortunately, the benefits of such broad, comprehensive treatment would not be sacrificed nor prevented by the carrying out of the proposed improvements by the city of Buffalo alone, provided the regulation works needed to maintain present conditions in the upper parts of the flooded sections outside the city be deferred. The entire subject is one that warrants much more extended consideration than is possible to give it under this investigation. The Legislature in 1900 authorized the city to carry out improvements on the streams in question within the city limits and to secure navigable conditions in all the streams except in Cazenovia creek, and gave the city powers of eminent domain for the purpose. It also authorized the issue of bonds to an amount of $250,000, which was in 1902 increased to $350,000. The authorization also provided that not more than one-third the total cost of the improvements should be borne by the city at large, the balance being raised by assessment on the property benefited. The Commissioner of Public Works, Col. Francis G.

Ward, has estimated that the channel improvements alone, apart from right of way, bridges and other expenses, would be about $750,000. The question involves in addition to flood improvement proper, the matter of creating a navigable stream and the attendant questions of Federal control and the liability for the cost of bridges over such navigable channels.

LAKE ONTARIO WATER-SHED.

This water-shed comprises the rather narrow strip of territory draining directly into Lake Ontario, extending from Niagara river to Irondequoit bay, with the exception of the Genesee river, which has been treated as a distinct water-shed by itself. The total drainage area of this district comprises 1,050 square miles, and the following are the principal streams:

TABLE XIII.

STREAMS DIRECTLY TRIBUTARY TO LAKE ONTARIO, NOT INCLUDING GENESEE RIVER, AND DRAINAGE AREAS.

	Square miles.
Eighteen Mile creek	90
Johnson creek	105
Oak Orchard creek	295
Sandy creek	85
West and Salmon creeks	110
Irondequoit river	135

The streams on this water-shed on which flood conditions are most severe are those of Eighteen Mile creek and Oak Orchard creek.

Eighteen Mile Creek.— Eighteen Mile creek was originally a small stream rising near Gasport and flowing first westerly and then northerly to Lake Ontario at Olcott; with another and a smaller branch of the stream rising a few miles south of Lockport. It is not understood that in its original and natural condition the stream was very seriously affected by floods.

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For many years past the Lockport branch of the stream has received large amounts of water from the water powers at Lockport which draw their supply from the Erie canal. During recent years this amount has become so great that at times the channel of the creek has been unable to carry its natural flow and its artificial contribution, and inundating of the farming lands along the creek valley in the town of Lockport and New Fane has occurred.

A State appropriation was passed in 1898 appropriating $15,000 for the purpose of preventing these floods by straightening some of the more tortuous portions of the channel and enlarging other portions.

The matter of floods on Eighteen Mile creek presents no special engineering or hydraulic difficulties whatever. Whatever flooding occurs is due wholly to artificial conditions at Lockport, and the remedy or prevention is simply one of proper regulation of the discharge of water from the canal at Lockport.

Oak Orchard Creek and Tonawanda Creek.—Although Tonawanda creek is not a tributary of this watershed, it will be considered here in connection with Oak Orchard creek owing to the fact that the drainage areas of the two streams merge into one another in the Tonawanda and Oak Orchard swamps, and also owing to the fact that a portion of the Tonawanda waters are diverted into the Oak Orchard swamp and creek by the Oak Orchard feeder.

Oak Orchard creek itself has its source in the eastern part of Orleans county, whence it flows through swamps and swampy channels westerly as far as West Shelby in the town of Shelby, at which point the swamp region ends and the stream flows northeasterly to Lake Ontario at Point Breeze. The distance from the head of the swamp in the western part of the towns of Clarendon, Orleans county, and Byron, Genesee county, to the foot of the swamp near West Shelby in the town of Shelby, Orleans county, is 16 miles in direct line, but is upwards of 20 miles following the stream channel. The fall of the stream for this distance is 37 feet, making the average slope of the stream

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surface 1 8-10 feet per mile, and the average slope of the swampy surface in a general westerly direction 2 3-10 feet per mile. The entire topography of the country adjacent to the swamp is very level, and the boundaries of the swamp accordingly are indefinite; large areas of land around the margin of the swamp being wet at certain seasons of the year and dry at others.

As stated in the description of the topography of Tonawanda creek, the fall of Tonawanda creek from the foot of the Oak Orchard diversion dam to Pendleton, the point at which the Erie canal enters Tonawanda creek, is 45 feet in a distance of 15 miles measured directly, or of 29 miles as measured along the tortuous swamp channel, giving a slope of about 1½ feet per mile to the stream surface.

This tortuous alignment and flat slope, coupled with the low, flat character of the topography adjacent to the stream, causes marshy conditions to exist along the portion of the creek lying in the towns of Royalton, Lockport and Wheatland, in Niagara county, and in Newstead, Amherst, Clarence and Tonawanda, in Erie county.

In a report, submitted in 1881 to the New York State Board of Health, by Mr. Emil Kuichling Mem. Am. Soc. C. E., on his examination of the Tonawanda and Oak Orchard swamps, Mr. Kuichling states that there are about 20,000 acres of imperfectly drained or marshy land lying along this portion of Tonawanda creek; and about 25,000 acres in Oak Orchard swamp. On the Oak Orchard drainage area swamp lands occur in the towns of Alabama, Byron, Elba and Oakfield, in Genesee county, and in Barre, Clarendon and Shelby, in Orleans county. The drainage area of the Oak Orchard swamp is about 85,000 acres.

The Oak Orchard swamp is due primarily to the outcrop of a rocky ledge which forms a barrier to the free flow of the waters at the foot of the swamp, and this comprises the chief obstacle in the way of the reclamation of this portion of the swamp. Oak Orchard swamp has been modified from its original condition by three agencies; first, the cutting of the timber from the adjacent territory and from its watershed generally has materially diminished the swamp area, which is stated to

have been originally upwards of 80,000 acres; second, the artificial diversion of a portion of the waters of Tonawanda creek by the Oak Orchard feeder, built in 1820 as an adjunct to the Erie canal, has aggravated the flooded conditions of the lower portion of the swamp; and, third, the partial lowering of the channel at the outlet of the swamp through the rocky ledge at the expense of the State, has tended to ameliorate the conditions and in some measure to compensate for the artificial flooding due to the Oak Orchard feeder. In the aggregate, there is little doubt but that the present conditions of the lands in the lower portion of the swamp are injuriously affected by the existence of the Oak Orchard feeder to a degree and character of injury not compensated by the work of the channel improvement so far as it has been accomplished up to this time. Entirely apart from the water diverted from Tonawanda creek itself by the diversion dam, the Oak Orchard feeder traverses the line of an original tributary to Tonawanda creek, namely Whitney creek, and as this stream is taken directly into the feeder its waters are diverted from their normal drainage to Tonawanda creek into Oak Orchard creek. As proof that the artificial waters from Tonawanda creek seriously aggravate the swampy conditions in the lower end of the swamp, evidence from a number of independent sources establishes the fact that after heavy storms the water passing down the feeder reaches Oak Orchard creek in such volume that it flows both ways, some of it passing out through the restricted channel over and through the rocky ledge, while other parts flow upstream into the swamp, to return again after the flow in the feeder has somewhat subsided.

The existence of the swamp lands in the heart of an otherwise fertile and favorable region has long been held by medical and sanitary authorities of that region to be a very serious detriment to the welfare of the country adjacent to it. The relation between the existence of swampy land in a region and the occurrence of malaria is well established, and within the last few years the cause of this relation has been fully determined. It is now accepted as established that the mosquito

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constitutes the connecting link between marshes and malaria and that the only remedy for malaria lies in the eradication of the malarial-bearing mosquito, a species called "Anopheles" which inhabits fresh water swamps and places where rank moisture prevails, and cannot breed nor develop in the absence of these, since the eggs of this species are deposited on the surface of perfectly quiet or stagnant water. Although the species may be destroyed by various insecticides, such as kerosene, still this form of remedy is not available on extensive areas like those under consideration; and the only remaining remedy lies in the destroying of conditions favorable to the malaria-breeding mosquito, namely, in the drainage of the swamps and wet lands.

The following evidence may be cited to establish the direct and positive relation between the existence of marshes and the low sanitary standard among the inhabitants of the region. Mr. C. C. Vermeule, in a paper before the Sanitary Association of New Jersey, in 1896, stated that the deaths from intermittent and enteric fevers and diarrhoeal diseases for the one-half of the population who live within the influence of the New Jersey marshes was 50 per cent. greater than for the other half of the population. In a communication to the New Jersey State Medical Society, in 1871, Dr. Culver, writing about Hudson county, which has one-half of its total area in marshes, says: "No part of Hudson county is ever exempt from malarial diseases." Dr. A. W. Blythe, in his "Dictionary of Hygiene and Public Health," says concerning marshes: "That at Rochforte, on the western coast of France and surrounded by marshes, the mean duration of life during the early part of the nineteenth century was only nineteen years." Melier, in his "Rapport sur le Marais salants," states that in certain communes of the department of Charante-Inferieure, a marshy region, the annual mortality from malarial diseases was 1 in 13 of the population. The same authority states that Marennes, a town with marshes on one side, is alternately attacked by, and preserved from, malaria according to whether the wind is from or toward the marshes.

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The relation of marshes to the public health of the adjacent community is still further shown by the following instances where direct and striking improvements in sanitary conditions have been accomplished by the draining of marshes: Mr. Emil Kuichling, in his report above mentioned, states that about 1860 a large marsh near Goshen, Orange county, N. Y., was pronounced dengerously unhealthy on account of the malaria generated there. Upon the draining of the marsh the disease was quickly dispelled from the region. Also the abandonment of the Chemung canal, in New York State, caused a portion of the canal between Havana and Horseheads to become stagnant and malaria soon became prevalent; on being brought to the attention of the State Board of Health, the defective drainage was quickly rectified during July, 1881, and in September of the same year the sickness had almost entirely ceased along the entire course of nine miles, where nearly all had been suffering from malarial fever. Dr. Henry F. Lyster, in the Michigan State Board of Health report for 1874, reported that in Genesee county in that State drainage had reduced malaria 50 per cent., and had improved the general health to a similar extent. The improvement of the Dombs, a large marshy district near Lyons, France, changed the region formerly notorious for its unhealthiness into a healthy region, and the average duration of life was extended from 23 years to 38 years. England carried out an extensive sanitary improvement in the draining of some 300,000 acres of marshy lands in the Fens on the east coast; before the improvement the occurrence of fever and ague in every family was the rule. Since the drainage has been completed the fever and ague has entirely disappeared.

The sanitary reasons for swamp drainage are, however, not the only ones in its favor. The common English adage may be reversed into the form of "Drainage for Health is Drainage for Wealth." The greater portion of the swamp lands in New York State are extremely fertile and productive. The case of the Orange county marsh may be cited as an instance where drainage raised the value of the land from $5 to $10 an acre before the drainage up to $300 to $500 an acre after drainage.

This is probably an exceptional case, but admits of a very wide margin of modification.

Mr. Kuichling, in his report, states that in the Oak Orchard swamp the soil is a very rich, black muck and attains a depth of several feet, while in the Tonawanda swamp more clay and loam are mingled with the vegetable mould, making the surface soil more compact and impervious. The black muck which is distributed over the whole of Oak Orchard swamp, and also over parts of Tonawanda swamp, is evidently very fertile. Judging from present land values in this vicinity in general and from the probable fertility of these lands, their value after reclamation can hardly be estimated at less than $100 an acre. These lands are at present entirely withdrawn from cultivation, and substantially from taxation; they are rarely assessed at more than $5 per acre, and it is recognized that their only present value lies in the timber on them. Their reclamation, therefore, would not only improve sanitary conditions, but would materially enhance the wealth of the State and its productive capacity.

The above remarks apply generally to the most, if not all, of the swamp areas of New York State, though each district, of course, is surrounded by different local conditions. The reclamation of these swampy districts is generally not feasible under private effort; even combined effort on the part of individuals, without some central official agency, is inadequate to carry through the needed measures. The existing State drainage law was enacted in 1869, and in the attempt to make it effective it has been amended almost every year since that time. This law fairly meets the case of the reclamation of small tracts where but few interests are involved, but it is inadequate in the case of large undertakings, and though it has been repeatedly attempted, it has never yet been successfully applied to the several large areas awaiting reclamation in this State. There is need, therefore, for some more effective system by which these lands may be reclaimed than is offered by the present drainage law; and from the intimate relation between this matter of reclamation and stream flow it would seem both

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desirable and feasible that if the State is to inaugurate a system of flood prevention and water storage, it should be made sufficiently comprehensive and broad to provide also for the closely allied subject of swamp reclamation.

A local flood committee for Oak Orchard and Tonawanda swamps was appointed in July past and through its engineer, Mr. Joseph W. Holmes of Batavia, it has furnished the commission with a map of the Oak Orchard and Tonawanda swamps and a map of the improvements thus far effected in the Oak Orchard swamp outlet near Shelby. This local flood committee comprised the following gentlemen:

Hon. Irving L'Hommidieu, Medina; Mr. Joseph W. Holmes, C. E., Batavia; Mr. Fred S. Downs, Medina; Mr. J. J. Ryan, Medina; and Mr. R. W. Post, Shelby.

The report of this committee, together with the maps mentioned, will be found in the supplement of this report.

Senator L'Hommedieu, chairman of the committee, estimates the money damages arising from flooded conditions directly due to the floods of 1902 to be $100,000.

DAMAGES FROM FLOODS.

While this investigation has not included any exhausted inquiry into the measure of the financial damages caused by floods a considerable amount of statistical information has been collected. The aggregate of these damages here represented is, of course, only a partial exhibit of the losses suffered and probably a relatively small part. A statement of some of these items of damage is as follows:

TABLE XIV.

PARTIAL EXHIBIT OF DAMAGES FROM 1902 FLOODS ON FIRST DIVISION.

Damages along the Genesee valley from Rochester to Belfast, 70 miles, as reported by the Rochester Flood Committee.....	$800,000 00
City of Olean, as reported by City Engineer Allen, $4,000 to $6,000.....	5,000 00

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Allegany county, as reported to the Board of Supervisors by Supt. Henry Stevens, of Andover, damages to public property, $278,400; damages to private property, $331,500; total..	$609,900 00
Damages to roads and bridges in Wyoming county, as reported to the Board of Supervisors.....	90,000 00
Damages in the city of Hornellsville, as reported by the Hornellsville Flood Committee.....	50,000 00
Mr. O. D. Sprague, clerk of the Board of Supervisors of Cattaraugus county, reports the damages to railroads and bridges to two towns in Cattaraugus county as follows:	
Perrysburg.....	2,000 00
New Albion.....	20,000 00
Damages in the town of Canisteo, Steuben county, as reported by the Canisteo Flood Committee, has damages to railroads, bridges and dyking, $22,500; damages to private property, $62,800; total.....	85,300 00
Damages in the city of Buffalo, as reported by Deputy Engineer Commissioner Morse.....	34,000 00
Damages to cultivated lands adjacent to Oak Orchard swamp, as reported by the chairman of the Oak Orchard Flood Committee.....	100,000 00
Mr. Fred W. Hastings, clerk of the Board of Supervisors of Steuben county, reports the following bond issues by towns in Steuben county, to cover losses from flood damages to railroads and bridges as follows:	
Town of Pulteney.....	6,200 00
Town of Hornellsville.....	6,000 00
Town of Wheeler.....	2,000 00
Town of Urbana.....	1,000 00
City Engineer Leon D. Conkling reports damages to the city of Elmira amounting to.....	155,000 00
	$1,832,400 00

Damages to Railroads.

Erie Railroad, as reported by Chief C. W. Buchholz	$228,000 00
Buffalo and Susquehanna Railroad, as reported by H. C. Landon, Engineer Maintenance of Way	4,400 00
Pittsburg, Shawmut and Northern Railroad, as reported by Chief Engineer M. F. Bonzano	15,000 00
Buffalo, Rochester and Pittsburg, as reported by Chief Engineer J. M. Floesch	15,000 00
Delaware, Lackawanna and Western Railroad, as reported by President W. H. Truesdale	5,700 00
Total	$2,234,500 00

In appendix No. 1, under part III, will be found the several reports of the local flood committees appointed at the several places where flood conditions have been found to be most serious, and these local reports are accompanied by maps and drawings descriptive of the subject-matter of the reports.

In conclusion the commissioners assigned to the First Division take occasion to express their regret that the limitations of time and money under which they have endeavored to carry out the purpose of their appointment, have contributed to prevent the thorough consideration of the subject which its importance to the people of the State demands.

Very respectfully submitted,

D. C. MIDDLETON,
OLIN H. LANDRETH,
Commissioners

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REPORT OF THE SECOND OR CENTRAL DIVISION.

COMPRISING THE WATERSHEDS OF THE FINGER LAKES, AND OF THE OSWEGO, SENECA, ONEIDA, SUSQUEHANNA AND DELAWARE RIVERS.

Commissioner RAFTER.

Commissioner KING.

REPORT OF SUB-COMMITTEE FOR SECOND DIVISION.

ROCHESTER, N. Y., *December* 8, 1902.

To the Water Storage Commission:

GENTLEMEN.— The undersigned reports as follows relative to the outlook for river regulation in District No. 2, especially assigned to the charge of himself and John L. King, Esq.

Before discussing the local features involved, it is proper to give a brief account of what has been accomplished in river regulation in other places.

Antiquity of River Regulation.— River regulation is very old, and there is scarcely a phase of it that has not been considered at some time in the Old World. The Chinese rivers, particularly the Hoang-ho, were regulated by dykes and embankments over 4,000 years ago. The same is true of the Euphrates and many other rivers on which were situated the cities of the ancient world. This statement is especially true of the River Tiber, at Rome. In the year 53 B. C.— 1,955 years ago — a proposition was brought forward in the Roman Senate for moderating the frequent inundations of this stream, which resulted in the appointment of five Senators as a River Conservancy Commission, to whom was assigned the task of so

regulating the volume of water in the river that there might be "no defnciency in summer and no injurious excess in winter." * So far as known, this was the earliest River Conservancy Commission. This commission does not appear to have regulated the river very effectively, since many inundations occurred afterwards, and in 1495 A. D. an accurate record of overflows was commenced. The flood of 1495 was, with a few exceptions, one of the heaviest known. Since that time serious floods have occurred on the Tiber in 1530, 1557, 1598, 1606, 1637, 1660, 1686, 1702, 1750, 1805, 1843, 1846 and 1870.

The town of Ostia, when founded, in 633 B. C., was at the mouth of the Tiber, and soon had 80,000 inhabitants. In the course of years, Ostia was deprived of its port by the silt carried down by the Tiber. Thereupon, the Emperor Claudius, about the beginning of the Christian era, presented to the Roman Senate a project for forming a port three miles from the original mouth. A basin, with two moles, a breakwater, towers and a lighthouse, was executed and a canal opened to connect with the river. This canal silted up towards the end of the first century. The Emperor Trajan repaired the port, adding an internal basin. The canal which still forms the navigable mouth of the Tiber was opened about 110 A. D. Plutarch, in his life of Julius Caesar, states that Caesar intended to remedy the evil, by deepening the mouth of the Tiber, but that his death prevented the accomplishment of this task.

An extraordinary inundation of the Tiber is mentioned by the younger Pliny in his letter to Micrinus, as occurring in the reign of Trajan, who, as already stated, built a canal which still exists. The present length of this canal is about two and one-half miles.†

In reference to the reason why the Roman Senatorial River Conservancy Commission, appointed 1,955 years ago, did not succeed, it may be mentioned that there is absolutely but one remedy which can be applied to a river in order that there

* The Tiber and its Tributaries, by S. A. Smith, 1877, p. 60.

† W. Shelford, on Non-Tidal Rivers, Proc. Inst. C. E., Vol. LXXXII, pp. 7-8; and The Tiber and its Delta, by Prof. Ponzi, Proc. Inst. C. E., Vol. XLVII, pp. 342-344.

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may be no deficiency in summer and no injurious excess in winter, namely, water storage. If the writer recollects rightly, the valley of the Tiber does not present the proper conditions for applying this remedy. In its lower reaches, the Tiber flows through a broad plain, while in its upper reaches, the valleys are narrow, with steep slopes, accordingly rendering it impossible for large quantities of water to be stored. So far as known to the present writer, aside from Black river in this State, there is no river anywhere on which the task assigned to the Roman River Conservancy Commission could be successfully applied. On this stream it is not difficult to construct a single reservoir, which practically controls 1,889 square miles of catchment area. There may be other streams on which it is possible, but the writer has never met with them in his experience. The Racquette river basin can also be thus controlled by a single dam at Tupper lake.

River Regulation on the Seine.— The River Seine, of which there is a long record of inundations, may be briefly mentioned. The Seine is the most important river of France, not only on account of its being the highway for a flourishing inland trade, but in consequence of engineering works which have been carried out for its improvement. On this stream, the same as on others, the occurrence of high floods is due to the concentration of the rainfall at special periods of the year. The rainfall is considerably greater in the summer than in the winter months, but, owing to evaporation, the rains of summer have comparatively little influence upon the flow of the river, although a heavy rain during the winter months falling upon a saturated soil, when evaporation is inactive, causes a flood of which the height depends upon the amount of saturation of the basin by previous rains and the duration of the rainfall. Daily readings of the height of the river have been kept at Paris since 1732. During this time, thirty-one ordinary floods, twelve extraordinary, and two exceptional floods, in December, 1740, and in January, 1802, have occurred. A list is also given of five exceptional floods occurring between 1649 and 1732. In 1658 a severe flood followed the breaking up of ice in the river

after severe cold weather lasting five weeks. Of the forty-five large floods recorded since the commencement of the daily observations in 1732 only three occurred in the warm season, two of them appearing in the month of May and one in the month of September. The foregoing shows that regular floods of the Seine at Paris are almost wholly confined to the cold season.*

A record of floods has also been kept on a number of other important French rivers, as, for instance, the Caronne, of which special studies were made over forty years ago, the Loire and the Rhone, all of which are the subject of special extended memoirs.

A number of rivers of Germany and Austria have been studied carefully for from 50 to 100 years, but in the United States substantially nothing has been done until about twenty years ago, from whence it results that river conservancy is a new subject here, many persons supposing that nothing has ever been done anywhere.

Definition of River Conservancy.— The term river conservancy may be considered as comprising the following objects:

1. The preservation and improvement of a stream for domestic, sanitary and industrial purposes.

2. In the case of navigable streams, their maintenance and regulation for navigation.

3. The culture and preservation of fish.

4. The effectual drainage of the district through which a stream runs.

5. The abatement of injury to lands by floods.

The cause of floods is, broadly, excessive and irregular rainfall, although very heavy rainfalls may occur without causing a flood. General statements of why this is so have been made in the preceding paragraph regarding the River Seine. Indeed, an investigation into rainfall shows that the intensity of floods is due only very remotely to the amount of rainfall. On the contrary, floods are very closely related to height of ground

* The River Seine. By L. F. Vernon-Harcourt. Proc. Inst. C. E., Vol. LXXXIV, p. 210.

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water. For instance, on Genesee river, in August, 1893, when, as the result of a serious summer drought, ground water was very low, a rainfall of several inches only produced a slight flood of about 4,000 cubic feet per second, whereas, in July, 1902, preceded by rain enough to fill the ground with ground water, about the same amount of sudden rainfall produced a devastating flood of from 20,000 to 30,000 cubic feet per second.* Many other examples could be cited of this general truth, but, as the object at present is not specially to multiply proof on this point, a single one is sufficient, although it is proper to remark that the same phenomenon has been observed on many other streams.

Torrential and Gently Flowing Rivers.— Rivers may be divided into two classes, (1) torrential, and (2) gently flowing rivers. The first class have considerable fall and usually flow over impermeable strata, while the second class flow over alluvium. Many of the streams of New York State belong to both classes — in their upper reaches they are torrential, while in their lower they are gently flowing. This distinction is important to bear in mind in treating of the question of floods, because the floods of torrential rivers, while high, are of brief duration. Gently flowing rivers, on the contrary, have lower floods, but they continue for a longer time and are, therefore, likely to be much more injurious. In New York State the torrential streams generally flow through deep valleys and in many cases present excellent opportunities for water storage. Usually, the valleys of gently flowing streams are not suitable for storage reservoirs — the cost of the necessary barrage would in many instances, at any rate, prove insuperable.†

General Principles of River Regulation as Defined by Von Wex.— Perhaps as interesting a paper as any is one by Gustav Ritter von Wex, privy-councillor to the Emperor of

* Floods on Genesee river vary greatly in intensity. A flood of from 30,000 to 40,000 cubic feet per second at Mt. Morris is not likely to produce, owing to temporary storage on the flats, a flood of more than 20,000 cubic feet per second at Rochester. The preceding statement considers the flood as measured at Mt. Morris.

† The Conservancy of Rivers. By Wm. H. Wheeler and Arthur Jacob. Proc. Inst. C. E., Vol. LXVII, pp. 201 and 233.

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Austria, in which the governing principles of river regulation are so clearly set forth that one can hardly do better than to give an extended extract therefrom. Von Wex's memoir is limited to a brief general summary of the first principles requisite to the successful regulation of intractable rivers. The quotation follows:

"In every case, first of all the upper course of the river must be dealt with separately, and then the lower portion of it, together with its mouth, whether it empties itself into an estuary or into the open sea.

"From long experience it has been ascertained that every river or stream, following its natural course through wide tracts of level country, invariably, if the banks consist of deposits of earth or gravel, attacks them, the lighter particles being carried away, the heavier being deposited in the bed of the stream, so that in course of time its width increases while its depth decreases, and at the same time islands, sand-banks, bends, creeks and by-channels are formed.

"In rivers thus left to nature, the fall, mean velocity and force of the current are continually decreasing while the river-bed is rising; this naturally raises the general water-level relatively to the adjoining country, and exposes it to frequent inundation, the effects of which are disastrous floods and the formation of innumerable branches and by-channels which intersect the whole country, flooding and swamping it at every rise of the river, and rendering it in time unfit for habitation by either man or beast. Instances of this kind are at the present time to be met with in many parts of the world, notably in Asia, Africa and America.

"In order to deal effectually with such cases, namely, to abate the floods, and to prevent disasters accompanying them, as well as the ultimate formation of trackless swamps, the following procedure is recommended:

"1. A new channel following the course of the valley should be carefully laid down by the superintending engineer, either in a direct line or with easy bends, and when excavated, the

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entire body of water should be admitted into this new channel, the old bed and all by-channels being filled up.

"2. Having carefully determined—

"a. The discharge per second at low, mean high water level of a cross-section of the river, either immediately above or immediately below the portion to be regulated, and

"b. The increased fall which the new channel will afford; then the sectional area of the new bed must be fixed, according to approved hydraulic formulas, so as to allow of the passage of either an ordinary or an extraordinary volume of water.

"3. The water having been admitted, the next thing is to protect the banks by random rubble or by stone pitching in order to prevent the action of the current injuring them, or forming bends or creeks.

"4. After the completion of the above, the old river bed and by-channels should be filled up, the land thus reclaimed should by degrees be brought under cultivation; in the same manner the marshy tracts exposed hitherto to inundation, and fertilized by the deposit therefrom, should be raised by a coating of rich soil.

"5. If exceptionally high floods still overflow the banks and inflict loss and damage to the freshly cultivated valley, dikes at suitable distances apart will be necessary to confine such floods, and enable them to flow off gradually without causing damage.

"From forty-eight years' observation and experience of extensive works undertaken for the improvement of rivers, the author can confidently affirm that by careful attention to the points above recommended, even the most tortuous rivers and the swampiest valleys have, generally within a few years, but in some cases only after many years, yielded the most satisfactory results, as for instance —

"a. The increase of fall due to the more uniform section and more direct course, and the concentration and confinement of the stream within a single channel provided with firm banks, considerably increases the force and velocity of the current, which tend to deepen the channel, and to carry away the ma-

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terial thus scoured out as well as that brought down from above.

"b. By lowering the bed of the river, in some cases to the extent of from 3 to 6 feet, the general water level, both of the river and of the ground springs in the neighborhood, is proportionately lowered, so that the adjoining country is less liable to inundation, and the swamps are more easily drained and brought under cultivation.

"c. The velocity being accelerated in the new channel, as shown by (a), floods pass off more rapidly and do not rise so high, consequently the low country is seldom or never under water, or at any rate not to the same extent as before. If, however, these lesser and lower floods are to be entirely prevented, dikes parallel to the course of the river must be added.

"d. In rivers exposed to the action of frost, floating ice is apt to accumulate in the unregulated portions of its course, especially at sharp bends, and on shallows and sandbanks, occasionally to such an extent as entirely to obstruct the flow of the stream, and to raise the water in the river to such a height that it overflows the banks, inundates the neighboring country, and spreads ruin far and wide.

"When once a river has been regulated this cannot take place, as there would then be nothing to hinder the free passage of floating ice, and should a temporary stoppage occur, the concentrated force of the current would soon overcome every obstacle, by raising the blocks, and bearing them away without causing any flood.

"e. It is a matter of general experience that even in a deep river following a winding course and dividing into numerous branches navigation is often obstructed to such an extent that the river becomes all but impassable, yet when the same river has been regulated, a direct channel is provided, facilitating traffic and commerce, and increasing the prosperity of the country already improved by drainage and cultivation.

"f. On the banks of many rivers left to nature but a scanty population exists, invariably affected and often decimated by epidemics, and generally exhibiting an imperfect physical and

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mental development. After regulation, and by draining and cultivating the adjoining country, these evils disappear, the inhabitants improve in health, strength and intelligence, the population increases, new villages spring up, and prosperity reigns where before disease and poverty were rife. The government earns the hearty thanks of all thus benefited, and has at the same time fully recouped the capital laid out on the works by the increased revenues derived from the improved condition of the country.

"Where such an improvement of the waterway has been rationally executed, in accordance with the particular nature and requirements of the locality, most, if not all, of the above advantages have been secured; as may be proved by numerous instances of works of the kind executed years back in France, Germany, Austria, Switzerland and Italy. Moreover, the fact that the chambers of deputies of these states have, during the last few years, repeatedly devoted hundreds of millions of florins to the completion of works already begun, and to new undertakings of the same kind, is a proof that the importance and advantage of such improvements are fully recognized.

"As a complete description of even the most important works of this kind would far exceed the limits of a short paper, the author must confine himself to a brief review of those successfully accomplished on the Rhine.

"The Rhine, between Basle and Mannheim, has for centuries followed a tortuous course, abounding in sharp bends and dividing into many branches, through a valley between 5,000 and 6,000 metres broad. Having further repeatedly shifted its course, the whole valley became cut up by old channels; to a considerable extent, too, its natural fall was lost, owing to its sinuous course, and consequently the rate and force of the currents were so much diminished that deposit accumulated everywhere, raising the bed of the river and mean water-level to such a degree that the adjoining country was little better than a swamp. The bed of the Rhine being thus elevated, and its course so irregular, the flood-water could not flow off rapidly enough, but spread abroad, inundating the neighborhood, and destroying whole villages and townships.

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"The riverside communities had in all ages attempted, by dams and other protective works, to abate these evils, but with little success, as, owing to the winding course of the river, the floods confined at one point escaped at another, and took their defenses in reverse. This deplorable condition of the Rhine valley continued until the commencement of the present century, when the population, already greatly reduced by poverty and disease, was daily decreasing owing to emigration to America.

"Colonel Tulla, of the engineers, an eminent authority on hydraulics at that time, by repeated and unremitting exertions, induced the government, in 1817, to undertake a thorough survey of the entire Rhine valley. Upon that survey was based the project for the radical regulation of the Rhine bed, which was approved and ratified by treaty between the border States of France, Bavaria and the Grand Duchies of Baden and Hesse, and according to which the regulation of the Rhine was carried out during the years 1819-1863.

"The work consisted in regulating the course of the river and making it more direct. This necessitated the excavation of twenty-three considerable cuts, which reduced the distance by river between Mannheim and Basle from 252 to 169 kilometres, and increased the fall 30 per cent. Further, the stream was confined to a uniform channel of suitable section, both banks were substantially protected, the old river bed and all branches were filled in, and the land thus reclaimed was for the most part brought under cultivation.

"The above mentioned regulation of the Rhine may be considered one of the most extensive and interesting undertakings of the kind ever attempted in Europe. It is proved that the following advantages have been secured:

"a. The river has undeviatingly followed the new course provided for it; has deepened its bed to the extent of two metres in some places, and lowered the mean water-level proportionately. Flood-water also has been passed more quickly.

"b. The general water-level being thus reduced in height, extensive tracts of swampy ground have been laid dry and converted into fertile arable land. Further, more than 20,000

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hectares of old river bed, water-holes and sandbanks have been reclaimed, and brought in a great measure under cultivation; and, lastly, the low-lying tracts are now no longer exposed to inundations.

"c. The sanitary condition of the Rhine valley has visibly improved, and the general prosperity of the inhabitants materially increased.

"d. According to the concurrent reports of experts, government officials and local authorities, the benefits derived from the regulation of the Rhine are so considerable that the capital laid out has been amply repaid. Wherefore, in grateful recognition of the eminent services rendered by Colonel Tulla, the original promoter of the scheme, a statue has been erected in his honor at Maxau on the banks of the river.

"In one respect only has the regulation of the river not fulfilled the expectations of its promoters, viz., the extensive sandbanks formed at the confluence of its tributaries have rendered intercommunication with them both difficult and dangerous, because these feeders to the main stream enter it across bars little more than 0.60 or 1.50 metre below low-water level.

"Had the hydraulic engineers in 1817 correctly determined the minimum discharge of the Rhine, and at the same time anticipated a probable decrease of the same, they would have diminished the waterway, and thereby considerably reduced the deposit formation of such sandbanks so that the channels of communication between the Rhine and its tributaries would have remained more open to navigation."

In addition to the foregoing general principles, applying more particularly to the non-tidal portion of rivers, rivers emptying into the sea, or into an arm of the sea, may require special treatment, and while, aside from the Hudson river, there are few such in this State, and although the improvement of this stream has been assumed by the Federal government, nevertheless it is proper to briefly consider the general principles governing such an improvement.

Generally speaking, the regulation of rivers flowing into the sea is more costly than that hitherto treated of, because the

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volume of water is greater and the yielding nature of the silt forming the beds and banks, together with the violence of the stream and force of the waves, render it necessary that whatever the form of protection it shall have solid foundations and be executed in the most substantial manner.

According to Von Wex, the works necessary for the perfect regulation of such a river consist of:

1. Rendering the course as nearly straight as possible in order to increase the fall.

2. Inclosing the river at or near its outfall by means of dikes or jetties, and continuing the same beyond the bar and far enough out to sea to enable the current to carry the sand and mud away, thus preventing the formation of a bar at the mouth.

3. In order to protect the adjoining country from tidal inundation, it will be necessary to construct on either bank dikes at such distances that at ebb tide the force of the river will be sufficient to carry out to sea the silt, etc., deposited during the inflowing of the tide.

The foregoing principles of river regulation are general in their character, and apply in some degree to every river in the United States.*

The Scope of the Work of the Water Storage Commission.—Chapter 406 of the Laws of 1902 authorizes the Water Storage Commission to determine the causes of overflow of the various rivers and water courses of the State, and to determine what, if anything, can be done to prevent such overflow.

This act, if strictly construed, would limit the work of this Commission to flood abatement only, or rather to a study of the causes of floods. It would exclude the several other important sections of river conservancy as defined in the previous pages. It would especially exclude the extensive studies of the effects of floods made by this Commission. The Commission, however, has construed the act more broadly, since it can hardly be pre-

* The Regulation of Rivers and Waterways, with a View to the Prevention of Floods. By Gustav Ritter von Wex. Proc. Inst. C. E., Vol. LXIX, p. 323

sumed that the Legislature really intended to place any such limitation to the legitimate work of the Commission as would be implied by the foregoing. In this broader view, the Commission has considered that it was really to study river conservancy as including the several heads of the subjects previously defined, rather than the single head of the cause of floods and the abatement thereof.

In regard to the definition of river conservancy as given on a preceding page, it may be mentioned that the third head — the culture and preservation of fish — has already been fully cared for by the Fish, Forest and Game Commission of this State, and in regard to the second head — the maintenance and regulation of streams for navigation — this phase of the subject has been undertaken by the Federal government and is, therefore, not specially considered here. The first head — the preservation and improvement of a stream for domestic, sanitary and industrial purposes — the fourth head — the effectual drainage of the district through which the stream runs — and the fifth head — the abatement of injury to lands by floods — are specially considered. The three heads are inter-related and the discussion may proceed without further special subdivision.

Flood Overflows Not Necessariy Injurious.— In the first place, it may be pointed out that flood flows, when occuring either late in the fall or early in the spring, are not only not necessarily injurious, but may be a source of considerable benefit to agriculture. Streams carry, when in flood flow, a large amount of silt which is valuable for manure, which enriches land, and when the inundation is annual, it may be a source of unending fertility. To cite one case, the River Nile has maintained the fertility of its valley from time immemorial from this source. The same thing is true on Mohawk and Genesee rivers and many other streams of this State.

It is also true that floods in the late spring or early summer, after crops have been planted, may be a source of very serious damage, as, for instance, during the summer of 1902 very serious floods occurred in the month of July. Probably the damage from such floods in New York State exceeded, in 1902, $3,000,000.

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If damages of every kind could be reckoned they would amount to at least $1,000,000 in any year.

Irrigating Streams.— There is a class of streams which, through the tendency to elevate their beds and widen their channels noted in a previous section, have actually raised themselves several feet, and, in some cases, twenty to thirty feet, above the surrounding country, so that whenever there is an overflow from the main channel, the water runs away from the streams, considerably complicating the construction of permanent regulation works. But there are, fortunately, only a few such streams in this State and none of those very important. The Missouri, Mississippi, Red and other rivers may be cited as streams of this character. The writer also remembers the case of the clear fork of Brazos river, in Texas, where a railway bridge crossing the stream was set level, with a down grade to the east for one half mile of 20 feet, or the country one-half mile east of the stream was about 20 feet lower than at the stream. There was also a down grade to the west of from 20 to 30 feet per mile, for one and one-half miles. The writer's recollection is that two miles west the country was about 30 feet lower than at the stream. A small stream of this character was observed at Binghamton on the Flood Commission's visit to that place, June 19, 1902.

Insufficient Waterway of Bridges.— A number of circular letters were sent out by the Water Storage Commission and the answers thereto, in many cases, referred to the carrying away of bridges. In regard to such, the writer cannot but think that one main reason why bridges are so frequently carried away in floods, is because of insufficiency of the waterways. Every student of hydrology understands that the catchment area above a bridge should be carefully ascertained, and a waterway, large enough to allow for all contingencies, should be provided. Nevertheless, under the system of building bridges by road commissioners, this is hardly ever done. Economy seems to be the sole consideration. The result is that bridges are carried away, and the writer ventures the opinion

that enough money has been spent in the State of New York on renewal of highway bridges, alone, in the last ten to twenty years, to make permanent bridges over every stream in the State. So long as the fact remains as it is, the writer cannot but think that the carrying away of such bridges is due rather to the lack of definite knowledge on the part of the road commissioners than to severity of floods.

Before designing a permanent bridge, the catchment area above the proposed location should be ascertained, together with the heaviest rainfall. In case there happens to be gaugings of the stream, the maximum run-off may be obtained from the gaugings, but thus far there are gaugings of comparatively few of the New York streams, and probably the flood flow will require to be computed. As to just how this is accomplished is foreign to the purpose of this report, but it may be simply stated that there is no special difficulty, provided that the data of catchment and rainfall, together with the steepness of slope, length of catchment, etc., are known, in computing a flood flow from which a bridge opening may be ascertained that will be large enough to carry the maximum flood.

Lack of Data a Source of Difficulty.— One difficulty in designing regulation works arises from lack of data. The writer has appreciated this fact for a number of years, and when in 1898 he established, in connection with the deep waterways work, a considerable number of gauging stations, it was to some extent with reference to supplying such lack. In order to render data of this character accurate within 2 or 3 per cent. there should be a record about thirty years long. Such a record should include rainfall, maximum, or flood flows, and minimum, or low water flows. In this way only, can accurate knowledge of the regimen of streams be gained.

River Conservancy in England, Germany and France.— In England, largely due to the prevalence of the common law rule that every riparian proprietor owns to the thread of the channel, river conservancy has not made the progress which it should. The taxpayers have generally insisted that all who are to be taxed have a voice in determining the kind of regula-

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tion to be carried out. The result is that many important works have not been undertaken, and on many streams the work has been carried out piecemeal, thus greatly increasing the expense, with ineffectual results.

In Germany the system is quite different. Here the State assumes control of the main and navigable rivers, defraying the expenses of their management out of tolls collected from those using the streams for navigation, mill power and other purposes. The State claims absolute ownership in the waters and prevents any interference, even with tributary streams. In some cases the riparian owners may combine for purposes of draining lands and flood protection. On application to the government, they are constituted a conservancy authority, armed with powers to compel those who fail in their duty to construct the necessary protection works, or to maintain them. They may also tax all those who are benefited, but have no power to tax those occupying lands outside of the reach of floods. The State contributes a portion of the cost of protection works where such works have the effect of improving land and increasing its taxable value, on the principle that such increase is a source of profit to the State. The State also grants aid to townships, and if it becomes evident that nothing will cure the evil of flooding but a diversion of a part of the water, the State, by virtue of its property in the water, executes the work gratuitously.

The system of river conservancy in France is somewhat different from the German. In this country the general government has always undertaken the conservancy of navigable streams, and has recouped itself from navigation dues and other charges, but latterly taxation of this kind has been mostly abolished, and the government is now chargeable with nearly all the expenses connected with the conservancy of rivers, though in certain cases the owners are also taxed in proportion to their interests. In May, 1858, it was enacted that the State should undertake works for the protection of towns from inundation, providing also that the departments, communes and owners should contribute to the cost of the works in proportion

to their respective interests. There is an inland navigation system on nearly every river of any importance in France, which has, perhaps, to some extent, influenced the action of the State.*

The storage dam on the Furens river, at Saint-Etienne, was built to protect the city of Saint-Etienne from floods. About 64 per cent. of the total cost was paid by the city of Saint-Etienne, and the balance was paid by the department. The cost of construction of the Ternay dam, also in France, was borne by the State, town and manufacturing interests. A number of other storage dams have been built in France, in recent years, by a combination of the general government, department government, local or municipal government and private interests benefited.

The Cause of Floods.— While, broadly, the cause of floods has been stated as irregularity in the rainfall, we may now go somewhat further into the detail than this statement implies. The clearing up of lands and drainage of towns, together with farm drainage, are all efficient causes for floods. In a general way, the water falling in the form of rain or snow, runs off by these various means quicker than formerly. In the mean time, the channels of rivers have not been correspondingly enlarged to meet the increased demands upon them, with the result that overflows frequently ensue. An examination of rainfall statistics shows that as a whole the rainfall is no greater now than formerly, and the increased frequency of floods must, therefore, be ascribed to not only irregularity in the rainfall, but to the greater rapidity with which water runs off. Broadly, we may say that the higher the degree of civilization, the more quickly will surface water be discharged and, hence, without there is a corresponding increase in the discharging capacity of streams, floods will become more frequent, with their attendant evils.

Frequency of Floods.— This matter has been referred to in a preceding chapter, discussing floods on the Tiber and Seine.

* The Conservancy of Rivers. By Wheeler and Jacob. Proc. Inst. C. E., Vol. XLVII., pp. 246 and 311.

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Very serious floods have occurred on these streams as often as about once in thirty to fifty years. In the United States, there are no records long enough to show certainly how often floods may be expected, but probably their periods will not be materially different from these streams — in some cases, heavy floods have occurred on the Tiber only a few years apart and it is intended to indicate here only very general averages.

Are Storage Reservoirs Effectual in Preventing Floods?— There is considerable doubt about storage reservoirs being a universal remedy for floods. On some streams, excessive cost would preclude their use — that is to say, the benefits received would not be commensurate with the expense. On other streams, their use may be of the greatest value. Thus, on Genesee, 41 per cent. of the total catchment area can be controlled by a reservoir; on Salmon river, 55 per cent.; on Black river, 90 per cent.; and on the upper Hudson river, 50 per cent. On all these streams, the percentage of control is large enough to prevent destructive overflows.

Views of French Engineers.— The utility of storage reservoirs in diminishing damage from floods was taken under consideration in France in 1856. Investigations made in the valleys of the Seine, the Rhone, the Loire, the Garonne and other important rivers, resulted in a decision not to carry out the numerous reservoirs which had been proposed, owing to the uncertainty and doubtful efficacy of their action in floods.

Further investigations were made after the inundations of 1875. These latter observations show that in the case of the Garonne, a reservoir capacity of about 20,000,000,000 cubic feet would be required to protect Toulouse, and one of 50,000,000,000 to 60,000,000,000 to protect Agen and the rest of the basin. Unfortunately, the capacity of the reservoirs which could be constructed in the upper valley of the Garonne would amount to only about one-sixth of that required for protecting Toulouse. The investigations led to similar conclusions in the case of the lower Garonne, and the other principal river basins in France.*

*Annales des Ponts et Chaussees, 6th Series Vol. II, 1881, p. 5. Translation in Proc. Inst. C. E.

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So far as the Water Storage Commission's investigations have proceeded, it seems probable that there are a number of rivers in the State of New York, where a similar conclusion will be reached when a complete investigation has been made. This statement forcibly applies to many of the streams of the second district. Owing to lack of funds at its disposal, the investigations thus far made by the Water Storage Commission are necessarily tentative, and final conclusions cannot now be given.

In one particular, the French engineers seem to have been far from right in their investigation of the utility of storage reservoirs. Thus, the statement is made that such reservoirs, to be useful against floods, must be kept empty throughout the whole season when floods may occur. This, perhaps, may be true in France, but it is not at all true, under the different conditions of rainfall, in a number of cases in the State of New York. Possibly, the French engineers overlooked the moderating effect of a reservoir, with large water surface, upon a flood even when the reservoir is filled to the flow-line. The writer has discussed this question so extensively in his several reports to the State Engineer and Surveyor, and also in his report to the Board of Engineers on Deep Waterways, that he refers to it at this time, merely making the statement that a simple computation is given which shows that even under the adverse condition of water at the crest, the temporary storage on the water surface is in most cases great enough to practically double the time of a flood and hence to decrease its destructive effect.* The conclusion on this head, therefore, is that an extreme flood, which would not be effectually mitigated, even though a reservoir were full, would occur not oftener than once in a century.

Flood Warnings.— Since the flood wave in a river is progressive, some idea can be formed in advance as to the stages of water that will occur along the lower reaches of a river when the stages at points higher up are known. Judgment as to such cases is based upon the observed height in previous years. Hence, the value of a record of water stages in determining the

* Annual Repts. of State Engr. and Sur., for 1894 and 1896.

relation between the wave crest at various points along a river, but the relation between these will not be identically the same in all cases — it will depend upon the distribution of the rainfall and other cases, over the catchment basin of a river. The average of a great many cases gives a result which, though sometimes in error, is in most cases, nearly right.

Predictions as to the height of floods based on the preceding general method, have been kept in France since 1854, and in the United States on the Mississippi, Missouri, Ohio and other tributaries of the Mississippi, for the last fifteen to twenty years. Generally, the rivers of New York State are not long enough to make such predictions especially reliable, although on some of the longer rivers, they may be successfully applied. At Cincinnati, Louisville, and Cairo predictions may be made from two to six days in advance of a destructive flood.

This matter is merely mentioned here, as one of the practical outcomes of the study of floods in large streams. It is extensively discussed in Russell's Meteorology, to which the reader is referred for more extended information.*

Division of the State into Four Districts.— At an early meeting of the Commission, the territory was divided into for districts, the second district including the catchment areas of Oswego, Susquehanna, below Binghamton, and Delaware rivers. Aside from the Oswego river basin, less is known of this territory than any other portion of the State. The United States Geological Survey's topographical map has not yet been generally extended over the territory included in the Susquehanna and Delaware basins, and the labor of study has been, in consequence, materially increased. It has, therefore, not been as thoroughly compassed as could be desired.

An unfortunate accident to Mr. King, early in September, must be ascribed as a reason why this territory has not been more thoroughly studied. The time of the writer has been so

* See Chap. 10, River Stage Predictions, in Meteorology, Weather and Methods of Forecasting and River Flood Predictions in the United States. By Thomas Russell. A general resumé of the cause of floods is also given in Chap. 9 of the same work.

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fully occupied with other matters as to render it impossible for him to visit all of the large number of localities affected.

Description of Oswego River Basin.— This stream, with a total catchment area at its mouth of 5.02 square miles, flows into Lake Ontario at the city of Oswego. It is formed by the junction of Oneida and Seneca rivers, at Three Rivers Point, about 22 miles southerly from its mouth. Its main tributary, Seneca river, with a catchment area of 3,433 square miles, enters from the west at this point. The catchment area of Oneida river is 1,402 square miles, entering at Three Rivers Point from the east. Seneca river includes within its basin, Canandaigua, Keuka, Seneca, Cayuga, Owasco, Skaneateles, Otisco, Cross, Onondaga and Cazenovia lakes, with a water surface of about 229 square miles, while Oneida river includes Oneida lake, only, with a water surface of about 80 square miles. The total water surface of the Oswego river catchment area is about 309 square miles. In addition, there is about 221 square miles of flats and marsh, making a total area of 530 square miles of water surface, flats and marsh. For the whole Oswego basin, the area of water surface, flats and marsh is, therefore, about 10 per cent. of the total catchment area.

The following table, from the writer's paper, Water Resources of the State of New York, compiled a number of year ago, gives elevation above tide, in feet, area of water surface, in square miles, and catchment area, in square miles, for these several lakes. These quantities are approximate only, and may vary somewhat from later determinations:

ELEVATION AND AREA OF LAKES OF THE OSWEGO RIVER BASIN.

LAKE.	Elevation above tide, in feet.	Area of water, in squre miles.	Catchment area, in square miles.
Cananadaigua	686.0	18.6	175.0
Keuka	720.0	20.3	187.0
Seneca	444.0	66.0	707.0
Cayuga	381.0	66.8	1,593.0
Owasco	710.0	12.4	208.0
Skaneateles	867.0	12.8	73.0
Otisco	784.0	3.0	41.0
Cross	375.0	.....	.....
Onondaga	364.0	4.0	267.0
Cazenovia	1,190.0	2.8	9.0
Oneida	370.0	80.9	1,300.0

The chief tributaries of Seneca river are the outlets of the several lakes, Clyde river, formed by the junction of Canandaigua outlet and Mud creeks at Lyons, and Flint and Mud creeks, while the chief tributaries of Oneida lake and river are Butternut, Limestone, Chittenango, Cowasselon, Oneida, Wood and Fish creeks.

Owing to the large amount of temporary lake storage, the flood flows of Oswego river and its main tributaries, Seneca and Oneida rivers, are very low. They are only from 4 to 6 cubic feet per square mile per second, while on the tributaries, Chittenango, Oneida, Wood, and East and West branches of Fish creek, they run from 13 cubic feet per square mile per second to 80 cubic feet per square mile per second. The flood flows of Clyde river, Flint and Mud creeks, have never been measured, but taking into account steepness of slope and other considerations, they may be safely placed at from 20 to 40 cubic feet per square mile per second. A tabulation showing maximum and ordinary flood flows in the State of New York, may be found in the writer's report to the Board of Engineers on Deep Waterways, at pp. 790-92.*

Description of Susquehanna River.— This stream rises in the southern part of the State of New York, and flows into Pennsylvania at Waverly. At Athens, a few miles downstream from

* Report on Water Supply Investigation, Appendix 16.

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Waverly, the Chemung river comes in from the west. The chief tributary is the Chenango river, entering at Binghamton. Lesser tributaries to the west of this are Cataton and Owego creeks. The chief tributary of Chenango river is the Tioughnioga river. The chief tributaries of the Susquehanna east of Chenango river are Unadilla river, Otsego creek and Charlotte river. There are also a number of small tributaries entering from Pennsylvania, which are not specially taken into account at this time. The general course of that portion of Susquehanna river here treated is from east to west, and of its main tributary, Chenango river, from north to south.

According to statements in the Report of the State Engineer and Surveyor for 1901, the total catchment area of Susquehanna river, above Chenango river, is 2,400 square miles, of which 500 square miles are in Pennsylvania, the balance of 1,900 square miles being in New York. The catchment area of Susquehanna river above Oneonta is 686 square miles, and above mouth of Unadilla river, 914 square miles. The total catchment area of Chenango river above mouth is 1,582 square miles, and total catchment area of Susquehanna river below junction with Chenango river, 3,982 square miles.

Description of Delaware River.— The Delaware river leaves the State at Port Jervis. Its principal tributaries are the Neversink, Mongaup, and East and West branches of the Delaware. It rises in the western slopes of the Catskill mountains. The course of the two main branches of Delaware river is generally southwesterly, while that of the main river is southeasterly. The main tributaries flow from north to south.

Thus far no gaugings have been made in the catchment area of the Delaware river. The following are the approximate catchment areas:

	In square miles.
Total catchment area of Delaware river in New York..	2,580
Main stream below mouth of Neversink river.....	3,600
Main stream below Port Jervis.....	3,252
Main stream below junction of East and West branches,	1,604

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	In square miles.
West branch at mouth	685
West branch at Deposit, below Oquaga creek	519
Pepacton river at mouth	919
Above mouth of Beaverkill	520
Beaverkill creek	322
Oquaga creek	82
Little Delaware creek	53
Neversink river at mouth	346

The flood flows of this stream are undoubtedly very high — in many cases, no doubt, approximating from sixty to eighty cubic feet per square mile per second. The valleys are narrow and so far as explored, do not, generally speaking, offer any great opportunity for water storage. Without wishing to decide the matter finally, the writer cannot but think that the benefits derived from storage reservoirs in this basin would not be commensurate with the expense. The same is generally true of the Susquehanna basin, as well as to a large extent, of the Oswego, although it should not be overlooked that, were it not for the location of towns near the water line, the vast lake areas in the Oswego basin would afford an unparalleled opportunity for water storage on a grand scale. Generally, the shores of the lakes arise abruptly, and with railways, towns and other works of man eliminated, the entire storage of each of these catchments could be easily developed. As it is, however, there is little hope for any such result. The towns of Penn Yan, Geneva, Watkins, Aurora, Ithaca, etc., would require to be removed, at so great a cost as to again make the benefits incommensurate with the expense. Something can, however, be done, and it is suggested that a very careful investigation be made of all these lakes with reference to water storage.*

Swamp Lands in Oswego Basin.—As already stated, Oswego river catchment is of special interest because of the large amount of swamp lands which it contains. The United States

* Regulating works are now in process of construction for controlling Seneca Lake to the extent of a rise and fall of about 2 feet.

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Geological Survey's topographical map has been extended over substantially the whole of this basin. The following are the quantities of swamp land contained on the several sheets of this map:

	Acres.
Oneida sheet	3,110
Cazenovia sheet	1,500
Chittenango sheet	8,450
Syracuse sheet	16,010
Moravia sheet	1,250
Skaneateles sheet	1,310
Baldwinsville sheet	5,190
Auburn sheet	3,090
Fulton sheet	7,800
Ithaca sheet	1,680
Watkins sheet	970
Weedsport sheet	7,530
Geneva sheet	2,060
Clyde sheet	7,190
Phelps sheet	2,500
Penn Yan sheet	3,200
Naples sheet	1,770
Canandaigua sheet	2,880
Macedon sheet	4,080
Palmyra sheet	2,100
Total	83,670 = 130.7 sq. mi.

Montezuma marsh (not included in the above):

	Acres.
Clyde sheet	10,800
Geneva sheet	3,900
Weedsport sheet	11,570
Total	26,270 = 41.05 sq. mi.

The foregoing include swamp areas merely. There are in addition about fifty square miles of low and flat lands, which would be improved by drainage.

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Very urgent requests for the improvement of these lands have been received from Lyons, Weedsport, Potter and other places, and since such work is clearly in line with the work of this Commission, particular attention has been paid to such improvement. Some attempt has, indeed, been made for the drainage of Montezuma marsh in previous years, but owing to a neglect of some of the fundamental principles, laid down by von Wex, comparatively little improvement has resulted, although it is probable that there has been slight improvement. As regards Montezuma marsh, in case the barge canal should be carried out along the line of present Erie canal, the drainage of this marsh will be effected as incidental to this work, but the drainage of the numerous other swamp areas, as for instance, Cicero, Flint Creek swamp and others, can only be effected by works specially designed for each local case.

In order to give some idea of the value of such improvement, the writer is informed that swamp lands now sell at from $3 to $4 per acre. If such lands were effectually improved, so that they could be cultivated every year, they would be the most valuable in the State, and worth, even under the adverse conditions of agriculture at the present time, at least $60 per acre. But in order to make them of this value, after effectual drainage, they must be cleared and put in shape for cultivation, which will require a large amount of labor over and above the mere drainage. Assuming them to cost, with some of the adjacent low flat lands, an average of $5 per acre, the net gain in value would be $55 per acre, amounting, for 221 square miles, to $7,779,200. The effectual drainage of all the swamp and marsh areas of Oswego river basin can probably, if gone at systematically, be accomplished for a cost of from $2,000,000 to $3,000,000. This expense should be borne partly by the land owners and partly by the State — the proportion to be fixed on further consideration. There is no good reason why the State government should not inaugurate an improvement like this.

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While on this point it may be remarked that there is a marked tendency on the part of many people to exaggerate damages from floods, the extent of marsh areas, etc. For instance, the Flint swamp is stated by adjoining land owners to comprise about 8,000 acres, but a computation of it from the Geological Survey's topographical map shows that the total area does not exceed 3,600 acres. Such statements are undoubtedly made in perfect honesty, and the writer merely comments on them as a thing the Commission should guard against in every phase of the question studied. Practically every statement made to the Commission must be divided by two in order to be safe.

Among the larger swamps of this area may be mentioned one at the head of Canandaigua lake and on West river, with an area of about 2,000 acres of swamp and low lands; one on head of Seneca lake, of 1,000 acres; and Cicero swamp, with an area of 16,000 acres. As shown by the preceding tabulation, the area of Montezuma marsh proper is 26,270 acres.

Regulation of Seneca River.— Owing to the large amount of low flat land on Seneca river, flood damage is considerable, even though the flood flows are as low as from four to six cubic feet per square mile per second. At the Commission's visit to Syracuse, on May 12, Onondaga lake and a portion of Seneca river were inspected. A large area had been overflowed, substantially as shown on the accompanying map. This map was prepared in connection with the claims for damages on account of a flood on Oswego and Oneida rivers a number of years ago. It shows the Oswego and Seneca rivers from Phoenix to Baldwinsville, and Oneida river from Three Rivers point to Oak Orchard. The area likely to be flooded in an extreme flood is indicated by the dotted line for the whole distance.

The following information as to flood heights in Onondaga lake and Seneca river has been furnished by Henry C. Allen, C. E., Resident Engineer of Middle Division, New York State canals:

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Syracuse City Datum, tide water Albany = 361.98.

1902.			
March 11.	H. W., Onondaga lake at inlet	367.76	
12.	H. W., Onondaga lake at inlet	367.92	
14.	At Mud Lock	368.27	
	Above dam at Phoenix	363.97	
	Above dam at Fulton, Oswego Falls	351.11	
	Ordinary low water, Onondaga lake	361.98	
1901.			
June 17.	Water in lake, 7.91 (assumed datum)	363.62	T. W.
	Water in river, 7.67	363.38	

Southeast corner east abutment bridge seat railroad bridge over Onondaga creek near lake = + 8.87.

Distance from top of rail to water surface = 10.44.

Top of rail = + 12.08 city datum.

361.98

374.06 = Top rail T. W.

— 10.44

— 363.62 S. W. 6, 17, 1901.

The following letter from Henry T. Beach, C. E., of Syracuse, is self-explanatory:

SYRACUSE, N. Y., *November* 19, 1902.

GEORGE W. RAFTER, C. E.:

DEAR SIR.— I send to-day by express the tracing of the Oswego, Seneca and Oneida rivers, from Phoenix to Baldwinsville and Oak Orchard.

Below you will find what data I have regarding these streams. My datum-base is an arbitrary one, 100 feet below the coping of Lock 5, Oswego canal.

Crest of Phoenix dam (stone work)	87.32
Top of flash board (1887)	88.40
Top of wing wall of dam	93.84
Top of coping, guard lock (Phoenix)	93.52
Mitre sill, guard lock	81.02
Top of coping, lock 5	100.00

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OLD RECORDS OF HIGH WATER.

1856.— At Lock 5, 97.10; in Onondaga lake, 97.21.

1873.— At Phœnix, 93.56 (accurate); at Three Rivers, 97.73 (doubtful); at Lock 4, 100.99 (doubtful); at Oak Orchard, 98.36 (doubtful); at Baldwinsville, 102.28 (accurate).

N. B.— The marks at Phœnix and Baldwinsville are definite and made by men who are reliable; the others of 1873, do not conform to other known slopes, and were given by recollection by men who might or might not be careful observers.

OBSERVED HIGH WATER.

	Phœnix.	Three Rivers.	New Bridge.	Lock 5.	Onondaga Lake.	Baldwinsville.	Oak Orchard.
April 13, 1888	92.56	.....	94.68	95.67	.....	.....	.....
March 18, 1891	92.87	.....	.....	96.38	96.44	.....	.....
March 24, 1891	93.35	.....	.....	97.04	97.10	.....	.....
April 8, 1893	92.11	92.93	94.03	94.26	.....	94.71	94.96

HIGH WATER FLOW.

IN CUBIC FEET PER SECOND.

	Oswego.	Seneca, below Lock 5.	Seneca, above Lock 5.	Oneida.
April 8, 1893	13,200	7,200	6,600	6,000

OBSERVED LOW WATER.

	Phœnix.	Three Rivers.	New Bridge.	Lock 5.	Onondaga Lake.	Baldwinsville.	Oak Orchard.
Oct. 20, 1887	88.89	89.08	89.40	89.40	89.85	.....	.....
May 18, 1891	89.89	.....	.....	91.36	91.49	.....	.....
Aug. 16, 1892	89.67	89.98	.....	.....	.....	.....	90.83
Sept. 9	.....	.....	.....	90.40	.....	91.12	.....

LOW WATER FLOW.

IN CUBIC FEET PER SECOND.

	Oswego River at Phœnix.	Oswego River at New Bridge.	Seneca River.	Oneida River.	Outlet of Onondaga Lake.
Oct. 20, 1887	2,662	1,452	1,184	1,210	268

I have profiles and cross-sections of these rivers which I can send you if they will be of any service.

Yours respectfully,

(Signed.) H. T. BEACH.

The present crest of Phœnix dam is stated at 359.9, but the writer is not sure whether the crest was at this elevation when these levels were taken. The crest of Baldwinsville dam is at 372.0. As regards barge canal, it was proposed that flash boards be carried on this dam two feet in height, raising the water above the same to 374.0. The canal level at this elevation was to be continued to Savannah, a distance of 31.2 miles.

The general elevation of Montezuma marsh, in the vicinity of N. Y. C. & H. R. R. R. crossing, is 380.0. Hence, if this canal level were carried through as proposed, the ordinary low water surface would be about six feet below the surface of the marsh. By making the channel large enough to carry ordinary flood flows, there would be no difficulty about agricultural operations upon this marsh at any time. At Savannah, the general level of the marsh is 383.0, or nine feet above the ordinary water level of the canal. This renders it easy to drain the extensive tamarack swamps to the north of Savannah.

It would also render possible the drainage of the swamp in the vicinity of Lyons, to which the Lyons committee have referred, without prohibitive expense.

It may also be mentioned that the water surface elevation of Cayuga lake is 381.0, or seven feet above the proposed ordinary water level of enlarged canal. This would render it

necessary that regulating works be constructed at the foot of Cayuga Lake similar to those now in process at foot of Seneca lake, as otherwise there would be a tendency for that lake to lower seven feet. Undoubtedly some lowering would be beneficial at Ithaca, as well as at the foot of the lake, but whether it would stand anything like seven feet can not be answered until more definite information is obtained.

Reviewing the preceding information, it is probably clear that for any effectual improvement of Seneca and Oswego rivers, they must be taken up as a whole. One part of the difficulty in the previous improvements of Seneca river has undoubtedly been its piecemeal character. The river has not been considered as a whole, and hence the improvement has disappointed its projectors.

Cut-off below Phoenix.— Several days were spent about September 1, in exploring Seneca river in the vicinity of Syracuse, and one point visited was a proposed cut-off a short distance below Phœnix. It is possible that ice-gorges may form at this point in a spring break-up, but aside from possible mitigation of these, the writer doubts if a straightening of the river channel at this point would produce any appreciable effect on floods at Syracuse. One difficulty with Oswego river is a too restricted channel, which can only be remedied either by enlarging the same, or by causing less water to pass down. If Cayuga lake were lowered a few feet and so regulated as to withhold the spring floods, and a similar device adopted at Keuka, Canandaigua, Oneida and the other large lakes of this system, so that the spring floods were reduced from 30 to 50 per cent. in intensity, it is probable that the channel of Oswego river would carry this lessened amount of water without destructive overflow, but that any permanent improvement can be made without its costing considerable money is impossible.

The Gaskin's Reef.— The Gaskin's reef is situated on Seneca river about half way between Three Rivers point and the village of Belgium. The river channel here is much too small and the

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levels furnished by Mr. Allen show that on March 14, 1902, the water surface above this reef (at Mud lock) was 4.3 feet higher than at the dam at Phoenix, thus indicating the retarding effect of the restricted channel at this reef. At Oswego falls, the water surface was 12.9 feet lower, thereby indicating that there is some doubt whether a cut-off below Phoenix would be of much use.

The foregoing is cited not in the way of deciding the question absolutely, but merely by way of indicating that the information needs to be much more precise and extended before any large amounts of money are expended.

Floods in Onondaga Creek.— Onondaga creek, flowing into the southerly end of Onondaga lake, has been in serious flood flow, submerging a portion of the city of Syracuse, a number times during the last few years. The city of Syracuse has works now in process which it is expected will alleviate the difficulty here. On May 13, the Commission visited a possible reservoir site, to the south of Syracuse, on Onondaga creek, where, so far as can be judged from casual examination, favorable conditions for the construction of a storage reservoir exist. In the absence of information as to flow of stream, size of catchment area, content of reservoir, etc., only very general views can be given in regard thereto.

Conclusions as to Oswego River Basin.— In the lack of definite surveys, extensive hydrologic and other information necessary for final decision, anything said at the present time is necessarily tentative and subject to modification in the future when the indispensable data shall be obtained. Broadly, we may say that this river needs to be considered as a whole — there should be a comprehensive survey extending from Cayuga lake to Oswego and including Oneida river to Oneida lake. A part of this survey has already been made in connection with the barge canal. Gaugings of the main and tributary streams should also be made for a series of years.* It is known that the flood flows are very small and we must, therefore, conclude that inadequate

* A number of gauging stations were established in this catchment area in connection with the deep waterways work, which have since been continued by the U. S. Geological Survey.

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channel and insufficient slope are the chief causes of flooding here. Probably, in order to completely remedy the several defects, a comprehensive improvement of the stream is required within the limits indicated. As to the cost of this, nothing is known, but the increased valuation of the swamp lands would undoubtedly justify the expenditure of a considerable sum of money.

Floods at Oneida.— On December 12, 1901, a very severe flood occured at Oneida, due to an overflow of Oneida creek. The cause of this flood is stated to have been the contracted waterway of Erie canal at Durhamville. Knight & Hopkins, civil engineers of Rome, examined into the matter and in a letter dated January 13, 1902, they stated:

"The principal cause is the damming by the contracted waterway for the Oneida creek to pass under the Erie canal at Durhamville. This caused the water to dam up on the upstream side at Durhamville approximately three and one-half feet higher than on the downstream side.

"The water at its highest stage stood about five inches less than the damming back by the Erie canal — or, in other words, had the canal embankment not been there, or had there been sufficient waterway through there, the water at its highest stage would have been probably about three and one-half feet lower than it was.

"The elevation of the surface of the water in Oneida creek on January 1, 1902, on the upstream side of the canal at Durhamville was 13.19 feet lower than at the time of the flood under consideration; and at the same date, namely, January 1, 1902, the surface of the water in Oneida creek at New York Central and Hudson River Railroad was 10.4 feet lower than at the time of the flood, showing an actual damming of 2.79 feet due to some cause. Now, as the channel of Oneida creek is not seriously contracted at any point below the point where the above levels were taken, except at the Erie canal embankment — and also from the fact that such observations as we have made on the flood levels between these two points indicate that the water had a fairly uniform grade between the railroad and

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canal — we are of the opinion that the principal, if not the sole cause for the water rising so high, was the damming of three and one-half feet at the Erie canal at Durhamville.

"We accompany this report with a map of Oneida creek from the Olney Canning Company's factory to Durhamville, which is simply an enlargement of the United States Geological Survey maps of this State; also a profile along the creek.

"The high water elevations are shown only at the Olney factory and above and below the New York Central Railroad and the Erie canal. There is also shown the surface of water in the creek on January 1, 1962, at various places. All these elevations are referred to tide-water.

"The middle line shown on the profile is the assumed elevation that the high flood would have produced had its flow not been obstructed at the Erie canal embankment."

The plan and profile of Oneida creek, made by Knight & Hopkins, are herewith included. A number of photographs are also given, which show the magnitude of the flood in the lower portion of Oneida.

Floods at Lyons.— The committee appointed by the president of the village of Lyons, have submitted an interesting report, the main portion of which, in regard to swamp areas in that vicinity, has been already discussed. The committee also call attention to the unsatisfactory condition existing at the railway bridges across Clyde river, a short distance below Lyons. It is claimed that these bridges are set too low, and particularly is the claim made in reference to a new bridge just erected by the New York Central and Hudson River Railroad Company over Clyde river. The report of this committee is herewith appended, and is self-explanatory.

If an enlarged canal improvement is made, as detailed in a previous section, it will permit of materially lowering both the flood and low-water plane of Clyde river, greatly improving conditions at and about Lyons.

Floods at Weedsport.—A committee was appointed by the president of the village of Weedsport, which has done consider-

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able in the way of compiling data as to effect of floods on Montezuma marsh in that vicinity during the last few years. This report is self-explanatory, although the statement of Mr. W. A. Traver, of Weedsport, that the cause of the damage is largely the filling up of the stream at certain points, one of which is Jack's reef, near Cross lake; and that a coffer-dam, built a number of years ago at that point for the purpose of removing a bar in the river, is the principal cause of the difficulty on that stream, may be mentioned, and the fact noted that the preceding discussion has shown that the cause is much more extensive than stated by Mr. Traver. He also states that the water has not been down to the so-called low-water mark this season and only for a short time last year, which is due to the fact that in both years the rainfall was much larger than for a number of previous years.

Floods on Susquehanna River.— The entire region drained by Susquehanna river, both in New York State and in Pennsylvania, is not only mountainous, but largely denuded of timber, from which it results that the flood flows of this stream are necessarily very large. The catchment above Chenango river is 2,400 square miles. There is a State dam, formerly used in connection with Chenango canal, across this river at Binghamton, and Mr. S. E. Monroe, city engineer of Binghamton, has been kind enough to compile, for the use of the Commission, a map on which he has placed high-water elevations during the flood of March, 1902, together with a plan elevation and cross-section of dam. The figures show that the depth on the crest of this dam was 13.1 feet, with a difference of elevation above and below the dam of two feet. Computing the flow over this dam as a submerged weir, and making various corrections, including one for the water flowing through the lock at south side of river, it is found that the flood flow last March was about 70,000 to 80,000 cubic feet per second, or, possibly, at the rate of something over thirty-three cubic feet per square mile per second. A flow at this rate is somewhat less than might reasonably be expected, and accordingly it may be assumed with considerable confidence that the flood of last March was not the

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largest flood likely to occur on this part of Susquehanna river. Comparing it with other similar streams, there seems reason for supposing that at some time there may be a flood here of at least fifty cubic feet per second per square mile. Such extreme floods, however, do not occur more than once or twice in a century. Thus the flood of March, 1865, which is the largest known, approximated these figures.

The Flood of March, 1902, at Binghamton.— The city of Binghamton, with, according to the Census of 1900, a population of about 40,000, is situated on Susquehanna river at the mouth of Chenango river. The serious damage from flooding in March, 1902, was due to the overflow of Chenango river, although a small portion of the city was overflowed by the Susquehanna, as shown by the figures on the accompanying map.

The committee appointed by the mayor of Binghamton has submitted a very elaborate report as to the damage ensuing from this flood, from which it appears that the whole number of buildings damaged was 440, of which, in 176, the water stood over the first floor. The foregoing included 3 factories, 7 stores, 1 market, 2 churches and 1 greenhouse. The committee estimates that 264 houses, with water in cellars, were damaged to the amount of $30 each, or to a total of $7,920, and that 176 houses, with water over the first floor, were damaged $50 each, or a total of $8,800. The entire damage, therefore, amounted to $16,720.

The committee also submitted a detailed statement, with names of individuals, giving the assessed valuation of property in 1901 and also in 1902, showing a total decrease, due to flood damage, of $44,800.

The flood flow in March, 1902, may have been as high as from 40,000 to 45,000 cubic feet per second. The report of the committee is herewith appended.

Occasion may be taken to point out that there is a marked tendency to overrate the low water flows of streams and underrate the flood flows. The writer has given in his paper, Water Resources of the State of New York, a number of examples

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where minimum flows are as low as 0.1 of a cubic foot per square mile per second. In some cases, they may even go lower than this. As regards flood flows, it is much safer to consider the unit of square mile, rather than the total area of catchment. In this view, it is doubtful if Chenango river was at maximum flow during March, 1902, but it may at some time go as high as about 40 cubic feet per square mile per second. It is evident that if both Susquehanna and Chenango rivers should be in maximum flow at the same time, the damage at Binghamton might amount to several million dollars. The photographs herewith submitted show the conditions in the streets of Binghamton during the flood of March, 1902.

The remedy proposed by the citizens of Binghamton is to construct a dike along the west side of Chenango river, from the high land at either side, thus preventing an inflow of water to the flooded district. As shown on map, there is a stream of water flowing into Chenango river at this point, but this stream is not very large and it can be shut off from the river by a self-acting gate. This flooded area is on the west side of Chenango river, as shown on the map. Nearly opposite, and on the east side, there is a large area which is also flooded but on which the flooding is not considered especially objectionable. It is obvious that a dike on west side of river would be without effect on the east side.

Without wishing to give a final opinion, the writer cannot but think that the flood damage on Chenango river is quite widely extended and that what the river needs is consideration as a whole, or at any rate, it should be considered to above the mouth of the Tioughnioga, its chief tributary.

Floods in the Vicinity of Watkins.—A report was received from a commitee at Watkins, stating that great damage is caused by Catharine creek, as well as by Watkins Glen creek, and alleging that the old Chemung canal is largely the cause of the destructive overflows at that place. This report is herewith appended.

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Damage to Railways.— Letters were addressed to the New York Central and Hudson River Railway Company, to the Erie Railway Company, the Delaware, Lackawanna and Western Railway Company, and to the New York, Ontario and Western Railway Company, asking for a statement of flood damages during the year, 1902. Answers thereto have been received from Mr. W. J. Wilgus, chief engineer of the New York Central, and from Mr. J. E. Childs, general manager of the New York, Ontario and Western Railway. They are as follows:

NEW YORK, *October* 13, 1902.

MR. GEO. W. RAFTER, *State of New York Water Storage Commission, Rochester, New York:*

DEAR SIR.— Replying to your favor of September 27, asking for an estimate of damages that we sustained last year by reason of floods in the neighborhood of Macedon to Oneida, I give you as follows such an estimate, which I trust will be of service to you:

Chenango branch, washouts and scouring of roadbeds due to abnormal rains	$2,000
Main line, similar trouble, principally due to high water in Clyde and Seneca rivers	900
Syracuse Junction road, due principally to storms on the lake	2,600
West Shore, similar washouts due to abnormal rain fall	300
Total	$5,800

Yours very truly,

(Signed) W. J. WILGUS.

NEW YORK, *October* 11, 1902.

GEO. W. RAFTER, Esq., *Water Storage Commission, Rochester, New York:*

DEAR SIR.— I beg to acknowledge receipt of your favor of September 27, and in accordance with your request I send you

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the following statement in relation to effects of floods on this line since December last:

December 15, 1901.— The east branch of the Delaware was very high, so that it backed up the Beaverkill at the junction of the two rivers, and flooded all the flat land in the vicinity of East Branch station. The track was washed out in a number of places, and the traffic between Cook's Falls and Cadosia was interrupted for two days. The estimated amount of damage to tracks on account of this flood was about $40,000. On the same date the water in the Rondout valley was unusually high, and the new roadbed of the Ellenville & Kingston Railroad damaged to the extent of $4,000.

March 2, 1902.— There was very high water in the Wallkill river. The damage, however, to roadbed was very slight. Traffic between Middletown and Campbell hall was interrupted for two days.

March 13, 1902.— High water north of Oneida washed out a culvert and embankment near North Bay station. Damage estimated at $2,000.

July 20, 1902.— High water in the Chenango and Unadilla valleys carried away two small bridges on the New Berlin branch. Estimated damage to roadbed about $2,000. Traffic on the branch was interrupted for about 12 hours.

July 24, 1902.— A local storm in the Ellenville valley swept a portion of the roadbed away near Spring Glen, and caused the wreck of a train, and some injury to passengers.

August 1, 1902.—A local storm between Liberty and Livingston Manor, lasting only about 30 minutes, caused very high water in the Little Beaverkill and tributary streams. The roadbed was washed away in a number of places, and the abutments of two bridges overturned. Damage estimated at $12,000. All traffic between Livingston Manor and Liberty was suspended for 36 hours.

Sept. 28, 1902.— High water in all streams between Liberty and Cadosia. Estimated damage to the roadbed on account of slides and washouts, $12,000. Traffic between these points was suspended for 12 hours.

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We have had a large force of men with the work train constantly at work repairing the damage between Livingston Manor and Cadosia, caused by the flood of December 15, last, since early in the spring, but have not yet fully recovered from the effects of that flood.

I will say in a general way that, having been connected with this company for 21 years, floods have been more frequent during the past year than in any other two or three years since I have been connected with the company.

We have on our line, 28 acid factories, consuming a large amount of hard wood, beach, birch and maple, and the hill-tops and sides are becoming rapidly denuded, and I have no doubt that this has largely increased the damage by floods. Note the local storm between Liberty and Livingston Manor on August 1, which lasted only about 30 minutes, causing very high water in the Beaverkill and tributary streams, and damaging the roadbed to the extent of about $12,000.

These local floods, which develop and disappear so suddenly, would probably have been held in check had the timber not been cut away.

Yours truly,

(Signed.) J. E. CHILDS,
General Manager.

Answers to Circular Letter.—Answers to the circular letter, sent out by the Commission, were received from the following persons, in District No. 2:

(1.) Mr. F. J. Brewer, of Arcadia, Wayne county, in regard to floods on Mud creek.

(2.) Charles F. Brown, Esq., mayor of Cortland, in regard to floods on Otter and Dry creeks.

(3.) Mr. Charles A. Cameron, town clerk of Owego, Tioga county, in regard to floods on Susquehanna river, Owego creek and Apalachin creek.

(4.) Charles S. Caywood, Esq., president of the village of Weedsport, Cayuga county, in regard to floods on Seneca river.

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(5.) G. C. Chauncey, Esq., superintendent of Fulton Light, Heat and Power Company, of Fulton, Oswego county, in regard to floods on Oswego river.

(6.) Eli R. Clinton, Esq., supervisor, town of Butternuts, Otsego county, in regard to floods on Butternut creek.

(7.) Mr. F. J. Conner, city clerk, Oneida, Madison county, in regard to floods on Oneida creek.

(8.) Ira P. Cribb, Esq., Canandaigua, Ontario county, in regard to floods on Sucker brook, which runs through the in corporated village of Canandaigua, and on Canandaigua lake outlet.

(9.) M. W. Dodge, Esq., Rockland, Sullivan county, in regard to floods on Beaverkill river.

(10.) W. E. Donaldson, Esq., Observer U. S. Weather Bureau, Binghamton, in regard to floods on Susquehanna and Chenango rivers.

(11.) Hon. E. R. Dusenbury, Liberty, Sullivan county, in regard to floods on Beaverkill, Delaware, Mongaup and other smaller streams.

(12.) Charles A. Fuller, Esq., village president, Sherburne, Chenango county, in regard to floods on the Chenango river and its tributaries.

(13.) F. W. Hawes, Esq., village president, Macedon, Wayne county, in regard to Mud creek.

(14.) Robert J. Hoag, supervisor, town of Hardenburgh, Ulster county, in regard to floods on Beaverkill river, Dry and Mill brooks.

(15.) Fred B. Holcomb, Esq., supervisor, town of South Bristol, Ontario county, in regard to floods on Mud creek.

(16.) Mr. George A. Kilbourn, Jr., New London, Oneida county, in regard to floods on Wood and Fish creeks.

(17.) Wm. E. Leffurywan, Esq., village president, Watkins, Schuyler county, in regard to floods on Catharine creek, Watkins Glen creek and lake level of Chemung canal.

(18.) E. G. Lester, Esq., Fayetteville, Onondaga county, in regard to floods on Limestone creek.

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(19.) Frank L. Lewis, Esq., Naples, Ontario county, in regard to floods on Grimes Gully creek and Taunery Gully creek, and what is known as Big creek, after they unite.

(20.) Cassius Maples, Esq., Laurens, Otsego county, in regard to floods on Harrison creek, Shores creek and Otego creek.

(21.) A. G. Marion, Esq., city clerk, Ithaca, Thompson county, in regard to floods on Cascadilla creek, Six-Mile creek and Fall creek.

(22.) E. L. McKenzie, Esq., Greene, Chenango county, in regard to floods on Chenango river.

(23.) C. A. Nicholson, Esq., Trenton, Oneida county, in regard to floods on West Canada, Cincinnatta and Nine-Mile creeks.

(24.) B. F. Petheram, Esq., village president, Skaneateles, Onondaga county, saying they have no trouble from floods.

(25.) John C. Porr, Esq., Cochecton, Sullivan county, in regard to floods on Delaware river.

(26.) O. M. Race, Esq., village clerk, Middletown, Delaware county, in regard to floods on Delaware river and tributaries.

(27.) H. M. Riggs, Esq., Groton, Tompkins county, in regard to floods on Owasco inlet.

(28.) Joseph Rosch, Esq., village president, Winston, Sullivan county, in regard to floods on Bashas Kill.

(29.) Orin H. Sisson, Esq., village president, Fabius, Onondaga county, in regard to floods on Tioughnioga river.

(30.) Mr. H. E. Thomas, village clerk, Kirkland, Oneida county, in regard to floods on Oriskany creek.

(31.) James H. Tripp, Esq., Marathon, Cortland county, in regard to floods on Tioughnioga river, Merrills creek and Hunt creek.

(32.) Jno. Z. Twichell, Esq., Lumberland, Sullivan county, in regard to floods on Delaware river.

(33.) Dr. M. A. Veeder, Lyons, Wayne county, in regard to floods on Clyde river and Mud creek.

(34.) Charles E. Wells, Pen Yan, Yates county, in regard to floods on Flint creek, and a tributary of it, Nettle Valley creek.

(35.) J. B. Wilson, Esq., village president, Dryden, Tompkins

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county, in regard to floods on Virgil creek, Fall creek and outlet of Dryden lake.

(36.) George E. Wright, Esq., Verona, Oneida county, in regard to floods on Wood creek.

(37.) H. C. Wood, Esq., village clerk, Morrisville, Madison county, in regard to floods on the headwaters of the Chenango.

It was hoped to visit these several localities during the present year, but owing to their large number, many of them have not been visited for lack of time.

Relation of Forests to Floods.—The writer has shown in another place* that evergreen forests of spruce, pine, balsam and hemlock are moderate regulators of floods, and that when a catchment area is thoroughly covered with such, flood flows will be somewhat less intense than from either denuded or partially denuded areas.

A considerable portion of New York State is now deforested and the denuded area is increasing rapidly from year to year. According to a statement in the annual report of the Fish, Game and Forest Commission for 1900, the soft wood is cut on 80,000 acres of Adirondack forest alone, and the hard wood on over 20,000 acres in the Catskill forests, making over 100,000 acres per year on which the soft wood is cut in the Adirondacks and the hard wood in the Catskills. The foregoing figures indicate one reason why floods may be increasing in New York State. It is evident that the time is soon coming when, aside from the State protected forests there will be very little timber in New York.

Amount of Water Power in New York.—According to the census of 1900 the total number of horse power in use in the State of New York was 368,456. The writer has shown in another place that there is a possibility of developing in the Adirondack region alone, something like 800,000 horse power, and that for the entire State the practical development is over 1,500,000 horse power.

*The Relation of Rainfall to Runoff, Water Supply and Irrigation. Paper No. 80, of the U. S. Geological Survey.

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Water-Power Projects in New York State.— Something has already been done in New York in the way of water storage for power purposes. On the Hudson river a reservoir system has been proposed which can probably be developed to a total storage of at least 60,000,000,000 cubic feet. It is possible that a larger storage than this can be obtained, but in the absence of complete surveys, 60,000,000,000 cubic feet is, for the present, taken.

On Salmon river, a reservoir has been designed of over 7,000,000,000 cubic feet capacity. On Black river, one of 57,000,000,000 cubic feet capacity has been designed, while on Genesee river, the proposed reservoir has a capacity of 15,000,000,000 cubic feet. On all these streams, with the exception of Hudson river, the project has been fairly worked out, plans and estimates having been prepared in detail. On the Hudson river, not all the reservoirs proposed have been completely surveyed, but enough is known to justify the foregoing estimate.

These several reservoir systems have a total capacity of 139,000,000,000 cubic feet, an amount of water sufficient, if uniformly distributed, to produce continuously, under the existing conditions of fall on the several streams, about 400,000 horse power, worth, at $12 per year per horse power, $4,800,000. But $4,800,000 is the interest on $120,000,000; hence, this amount of money could be actually invested in combined flood protection and water storage for power purposes, before the project would become commercially impracticable As a matter of fact, the storage system here outlined will not exceed in cost $17,000,000. Such a project places, therefore, before the people of the State of New York, the possibility of commercial development, on sound manufacturing lines, far beyond anything thus far experienced in this State.

It may with propriety be asked, how is it possible to combine water storage with flood prevention, by means of storage reservoirs. The answer is that the two are alike in this, they both require the storage of vast quantities of water. In water stor-

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age for power purposes, the problem is to so adjust the outflow from a reservoir to the inflow, that the maximum run-off just fills up the reservoir, without the outflow during the minimum run-off ever absolutely depleting it. Owing to variations in the run-off streams, it is not possible to make such an adjustment absolute, although after some experience has been gained, the adjustment may be made quite close. For instance, on Genesee river, the reservoir is designed to hold 15,000,000,000 cubic feet of water, and to produce at Rochester a flow of at least 1,000 cubic feet per second every day in the year. These two facts express the required relation between rainfall and run-off, as they exist on this stream. The most satisfactory way of making the computation is to first keep a record of the flow of the stream for several years. With such a record, it becomes very simple to compute the state of the reservoir for any given month. The Genesee River reservoir has been computed in this manner from June, 1894, to November, 1896, during which time the total waste from the reservoir — that is, the amount which ran out over the spillway and was wasted — was 2.11 inches. The reservoir, when filled to the crest, contains 6.46 inches. The lowest point reached at any time was at the end of November, 1895, when only 0.44 inch remained in the reservoir. This reservoir, as designed, is 15 miles in length, an average of a mile in width, and an average of 60 feet in depth. The area flooded is 12.3 square miles and the catchment area 1,000 square miles.

On Black river, where the largest reservoir thus far proposed in this State, is situated, the area to be flooded is 73.2 square miles. The catchment area is 1,812 square miles. The daily outgo, for present purposes, may be taken at 2,500 cubic feet per second. The state of the reservoir, as computed by the method already indicated, shows that from 1892-98, inclusive, the total amount wasted over the spillway was 21.28 inches, but in the water years, 1894-96, inclusive, there was wasted only 0.19 inch. This reservoir has a total capacity of 13.5 inches, and at no time during the period from 1892-98, inclusive, was there less than 4.57 inches in the reservoir. The 4.57 inches of water is equal to 19,280,000,000 cubic feet.

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In the foregoing, the quantity of water in the reservoir is taken in inches in depth on the catchment area in order to preserve a common unit for purposes of comparison of the rainfall with the run-off.

It is obvious that when a reservoir is partially empty, it may take into it a very large flood without filling up, but even when the large reservoirs here considered are filled to crest of spillway, they will still mitigate the effect of floods by temporary storage on the surface of the reservoir. For instance, the Black River reservoir, with a water surface of over seventy-two square miles, will more than double the time of run-off of a given flood simply by temporary storage. If, therefore, the intensity of a flood were such as to make, without the reservoir, a flood flow of 40,000 cubic feet per second, by its means the time would be doubled and, consequently, the maximum flood cut in two, or it would be at the rate of only 20,000 cubic feet per second. Such a flood would pass down the channel of the stream without destructive overflow. The same thing is true of all reservoirs where there is considerable area for temporary storage. On streams with large lake areas, such as Oswego and Hudson rivers, the severity of floods is sensibly mitigated by the temporary storage furnished on the lake surfaces. On the Oswego river, where, as already stated, the lake and swamp areas amount to ten per cent. of the whole catchment, the flood flows do not exceed four to six cubic feet per square mile per second, while on the Hudson they are sixteen cubic feet per square mile per second. On the other hand, on the Genesee, above the outlets of Honeoye, Hemlock and Canadice lakes, the flood flows are 40 cubic feet per square mile per second, and on Chemung river, they are as much as 67 cubic feet per square mile per second. The Oswego river is the most marked case of reduction of intensity of floods due to temporary lake pondage known to the writer.

The topography of a portion of New York State lends itself admirably to such a reservoir system as is here suggested. A series of broad river valleys traverse the State in various direc-

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tions. Usually, solid rock foundations may be found within reasonable distance of the surface, insuring that nothing short of an earthquake may destroy the dams. Stone quarries likewise abound at every hand, and the system of internal navigation and railways insures the transportation of materials and supplies expeditiously and economically.

Mill Acts of Massachusetts and other States.— In order to show what may be accomplished in a comparatively small State, by properly encouraging manufacturing, the writer will refer to conditions as existing in the State of Massachusetts. This State has always been mindful of the interests of manufacturing and accordingly at the beginning of the eighteenth century, a mill act was enacted, and while the original act was merely intended to encourage the erection of grain and flour mills, it has been gradually extended to include all kinds of manufacturing operated by water power, on the ground that the Commonwealth was directly concerned in the development of all such. The writer has no intention of discussing the mill acts of Massachusetts in detail, and wishes merely to point out that such acts have also been enacted in Maine, Wisconsin, Rhode Island, New Hampshire, Connecticut, Vermont, Pennsylvania, Virginia, West Virginia, Kentucky, Mississippi, Alabama, Missouri, Indiana, Iowa, Illinois, Michigan, Nebraska, Minnesota, Kansas, North Carolina, Tennessee, Georgia, Delaware, Arkansas, Florida and Oregon, or in twenty-eight States in all. In New York State, we have been so wedded to the single idea of canals, that we have never enacted a mill act. That this failure has been to the material disadvantage of the State, may be easily shown. We will briefly touch upon a few points substantiating this statement.

Relation of State Area to Water Power.— The area of New York State, not including water surface, is about 49,000 square miles; of Massachusetts, about 8,000 square miles; of Connecticut, 5,000 square miles; and of Rhode Island, 1,200 square miles. The water power in use in these States, in 1900, was, in New York, 368,456 horse power; in Massachusetts, 187,848 horse

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power; in Connecticut, 71,414 horse power, and in Rhode Island, 29,035 horse power. Comparing the area of these states with New York, it appears that New York is about six times as large as Massachusetts. If the area of Massachusetts were the same as that of New York, there would have been, in 1900, something like 1,127,000 horse power in that State. The area of New York is nearly ten times as great as that of Connecticut. If the area were the same, there would have been, in 1900, over 700,000 horse power in Connecticut. The area of New York is forty times as great as that of Rhode Island. If Rhode Island had the same area as New York, there would have been in that State, in 1900, 1,160,000 horse power.

The extraordinary fact is, therefore, developed that Massachusetts, Connecticut and Rhode Island, all of which States have well-considered mill acts, have far outstripped New York in the development of water power.

Capital Invested in Manufacturing in New York, Massachusetts, Connecticut and Rhode Island.— The last census shows that in New York the total capital invested in manufacturing was $1,651,210,220; and the value of the annual manufactured product was $2,175,726,900.

In Massachusetts, according to the last census, the total capital invested in manufacturing was $823,264,287; and the value of the annual manufactured product was $1,035,198,989. If Massachusetts had the same area as New York, with proportionate manufacturing, the value of the annual manufactured product in Massachusetts would be over $6,000,000,000 or, roundly, three times as great as that of New York.

In Connecticut, the total capital invested in manufacturing in 1900, was $314,696,736; and the value of the annual manufactured product was $352,824,186. If Connecticut had the same area as New York, with proportionate manufacturing, the value of the annual manufactured product in Connecticut would be $3,528,241,860, or about one and one-half times as great as that of New York.

In Rhode Island, the total capital invested in manufatcuring in 1900, was $183,784,587; and the value of the annual manu-

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factured product was $184,074,378. If Rhode Island had the same area as New York, with proportionate manufacturing, the value of the annual manufactured product would be $7,362,975,120, or about three and one-half times as great as that of New York.

As to why this is so, the census report furnishes a decisive answer in the following language:

"The principal advantage which the State of Massachusetts possesses is its water power. * * * The power of the Connecticut river at Holyoke and at Turners Falls, in the town of Montague, utilized by means of immense dams of the most permanent construction, and by a system of canals affords in each place a succession of mill sites along the entire water frontage. The Deerfield, Millers, Chicopee and Westfield rivers, tributaries of the Connecticut, are all noteworthy power-producing streams. At Lowell and Lawrence, upon the Merrimac, the possession of similar advantages led to the selection of these places for the installation of the factory system in the manufacture of textiles. At Fall River the power furnished from Watuppa pond has been an essential element in the development of that cotton manufacturing center; while upon the Blackstone river, and many lesser streams throughout the State, the existence of sites naturally adapted to the erection of mills was influential in the expansion of the woolen and cotton industries in the early part of the century, thus laying the foundation of numerous thriving industrial communities."

In Massachusetts, Connecticut and Rhode Island a liberal policy towards manufacturing has always been exercised. There is a system of reservoirs practically utilizing the water power of every stream, and even comparatively small brooks are in many cases fully developed and are the source of wealth to the citizens.

Relation of Area to Population.— The final test of such statistics is as to the effect upon population. If we find population proportionately increased in Massachusetts, Connecticut and Rhode Island we may assume that a chief incentive has been

the rational encouragement of manufacturing through the operation of well-devised mill acts.

According to the census of 1900 the population of New York was 7,268,894; of Massachusetts, 2,805,346; of Connecticut, 908,420; and of Rhode Island, 428,556. Assuming that Massachusetts had the same area as New York, with population proportionate to its present population, we find a total population for Massachusetts, of 16,856,000; in Connecticut the actual population is 908,420; but with the area of New York, the proportionate population would be 9,084,200; the population of Rhode Island is, for an area of a little over 1,200 square miles, 428,556; with an area forty times as great — the equivalent of the area of New York — the population of Rhode Island would be 17,142,240. We reach, therefore, the conclusion that in Massachusetts, Connecticut and Rhode Island, on an actual area of a little over 14,000 square miles, with a present population of about 3,150,000, if we take the area proportionate to that of New York, with population proportionate to that of the States, themselves, there would have been in these States in 1900, about 43,000,000 persons — or the population on the 147,000 square miles, presupposed by the foregoing would have been about 43,000,000.

Relation of Values of Agricultural Products to Water Power Values.—Again, according to the last census, the total value of farm products in New York in 1900 was $245,270,600, of which we may assume 7 per cent. as profit, or the total profit becomes $17,160,000 annually.

In the writer's report on a water supply from the Adirondacks, made to the Merchants' Association of New York city, in 1900, he has shown that on Hudson river the net annual profit on each net horse power, is $16.20. The foregoing total of 1,500,000 is gross horse power, hence the net annual profit on a gross horse power, at this rate, would be, roundly, $12. The establishments on Hudson river are mostly paper mills, and without doubt in miscellaneous manufacturing, the profit is from three to five times as great as this, but we will assume it all over the State, for the purpose of the argument, at $12 per

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horse power. At this rate 1,500,000 horse power would pay an annual profit of $18,000,000, and represent, at 4 per cent., a capitalized investment of $450,000,000. We see also that water power may be easily made equal to agriculture, the net annual profits of these two industries being the same.

The Proper Remedy.— There are a number of remedies which may be applied, but the writer thinks that first of all we need a comprehensive act in this State which shall permit of developing water storage to its full capacity without any further grant of powers from the Legislature than those granted in the general act. As to the form of such an act, the writer is not specially insistent, although he may point out that the mill act of Massachusetts, by reason of long and successful application, is an excellent model. A copy of this act may be found in Angell on Water Courses. It is possible, however, that a mill act may not be in accord with the trend of legislation in this State.

The writer is also of the opinion that there should be a permanent State Commission, specially charged with the control of the rivers. To this Commission should be submitted everything relating to the rivers of the State. It should be given broad powers as regards the carrying out of projects for improvement, for preventing floods or for other purposes. Water storage projects should be submitted to it for decision. The Commission should have funds enough at its command to enable all necessary investigations to be made.

In the matter of the drainage of swamps and low lands, where an improvement in the public health may be reasonably expected, the State should pay a portion of the cost. On rivers like Hudson and Mohawk, where the State assumes to absolutely control the waters without regard to the rights or wishes of the riparian proprietors, the State should, in consideration of such control, make all necessary improvements at its own expense. On the rivers of the balance of the State, where a different rule prevails, the State may, in consideration of the

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abatement of floods and improvement of the public health, pay a portion of the cost.*

Summary.— Inasmuch as this report is somewhat lengthy, in order to assist in understanding it, the more important propositions are summarized as follows:

(1.) River regulation is very old. Systematic studies, of which there is a tolerably complete account, began nearly 2,000 years ago.

(2.) Records of floods have been kept on the River Tiber at Rome for over 400 years, and on the River Seine at Paris, about 175 years. A study of the flood flows of these streams shows that serious floods have a more or less definite period — they are more likely to occur in the fall, winter or spring than in the summer, although when the conditions are right, they sometimes occur in summer.

(3.) Comparatively little has been done in the United States except in the last 20 years.

(4.) River conservancy may be considered as comprising the preservation and improvement of a stream for domestic, sanitary and industrial purposes. The construction of storage reservoirs for the preservation and improvement of a stream may be assumed as included under this head. It also includes effectual drainage of the district through which a stream runs, together with the abatement of injury to lands by floods.

(5.) The cause of floods is irregularity of the rainfall, together with height of ground water and the clearing up and drainage of cities and towns, lands, farm drainage, etc.

(6.) Rivers may be divided into torrential and gently flowing rivers.

(7.) The general principles of river regulation by Gustav von Wex, are of value as presenting the main points governing this subject.

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*Relative to the law governing the Hudson and Mohawk and the other rivers of the State, see writer's report on Upper Hudson Storage, for 1895, pp. 188-93, inclusive.

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(8.) The work of the Water Storage Commission includes river conservancy rather than the single head of the cause of floods.

(10.) Insufficiency of waterways is frequently the cause of the carrying away of bridges by floods.

(11.) In England, river conservancy has not made the progress it should, although a considerable number of rivers have been partially regulated. The best work in river regulation has been done in Germany, France and Italy.

(12.) In Germany, the State claims absolute ownership in the waters, and largely constructs river regulation works at its own expense.

(13.) In France, the State undertakes the conservancy of navigable streams, paying most of the expense, though in certain cases, the owners are also taxed in proportion to their interests.

(14.) As to whether storage reservoirs are effectual in preventing floods, will depend entirely on conditions — on some streams excessive cost precludes their use, while on others, their use may be of the greatest value. The French engineers have concluded that for the conditions in France, generally speaking, such reservoirs have little utility, although a number have been constructed, but the catchments controlled by such are not large.

(15.) Flood warnings may be made on rivers of considerable length, but most of the rivers of this State, are too short to give the warning very much in advance of the flood.

(16.) There are about 172 square miles of swamp lands in the Oswego basin, which may be effectually drained at only a small proportion of the increased value resulting from the drainage.

(17.) Seneca and Oswego rivers require regulation from the mouth, at Oswego, to Cayuga lake, and Oneida river, from Three Rivers point to Oneida lake. The view that regulating works for a short distance only are beneficial, has been effectually nega-

tived by experience in other places. First of all, there should be a comprehensive survey of the entire river.

(18.) Serious floods have occurred at Lyons, Weedsport, Syracuse, Oneida and at other points in the Oswego basin.

(19.) The flow of Susquehanna river was probably at least 70,000 to 80,000 cubic feet per second in March, 1902.

(20.) There was a serious flood in Chenango river, at Binghamton, in March, 1902. Very heavy damages resulted from this flood.

(21.) The remedy proposed at Binghamton is to construct a dike along the west side of Chenango river, with a self-acting gate therein, to allow a small stream to flow through. Further investigations are needed in order to know whether this is the most effectual plan.

(22.) The New York Central and Hudson River Railroad Company and the New York, Ontario and Western Railroad Company, have suffered considerably from floods during the last season.

(23.) Evergreen forests of spruce, pine, balsam and hemlock are efficient regulators of floods.

(24.) The total number of horse power in use in New York State in 1900, was 368,456; 800,000 horse power can be developed in the Adirondack region, and 1,500,000 horse power in the whole State.

(25.) Water-power projects in New York State have been extensively considered on Hudson, Genesee, Salmon and Black rivers, and less extensively on a number of smaller streams. On these four large streams, the reservoirs designed have a total capacity of about 139,000,000,000 cubic feet, capable of producing an annual value of $4,800,000, or the interest on $120,000,000.

(26.) The large area of water surface of the reservoirs on Hudson, Genesee, Salmon and Black rivers, make it possible to use these reservoirs as efficient mitigators of floods and at the same time utilize them for water storage for developing power.

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(27.) The topography of New York lends itself to such a reservoir system as is here suggested.

(28.) Taking everything into account, a broad, well-devised act, which will permit of the development of water power on these several streams to their full capacity, without any further grant of powers, should be enacted by the next Legislature.

(29.) The land area of New York State is about 49,000 square miles, or six times as great as Massachusetts, ten times as great as Connecticut, and forty times as great as Rhode Island. If the area of Massachusetts, Connecticut and Rhode Island were the same as that of New York, with water power proportionate to what they now have, Massachusetts would have over 1,100,000 horse power; Connecticut over 700,000 horse power; and Rhode Island, nearly 1,200,000 horse power. Massachusetts, Connecticut and Rhode Island all have well-considered mill acts.

(30.) In Massachusetts, proportionate to area, the capital invested in manufacturing in 1900, was three times as great as that in New York; in Connecticut, one and one-half times as great; and in Rhode Island, nearly four times as great as in New York. The report in the twelfth census ascribes this difference purely to possession and rational development of water power.

(31.) The population of New York State in 1900 was 7,268,894. If Massachusetts, Connecticut and Rhode Island each had the same area as New York, with population proportionate to their present population, the total population in 1900 would have been, in Massachusetts, nearly 17,000,000; in Connecticut, nearly 9,000,000, and in Rhode Island, over 17,000,000.

(32.) The value of the agricultural productions in New York in 1900 was over $245,000,000, on which, assuming an annual profit of 7 per cent., the total annual value was over $17,000,000.

Assuming an annual value of $12 per horse power, 1,500,000 horse power — the ultimate possible for the State of New York — would pay an annual profit of $18,000,000, and represent, at 4 per cent., a capitalized investment of $450,000,000. It is obvious, therefore, that water power in New York may be made equal to, or even somewhat in excess, of the value of agriculture.

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(33.) There should be a permanent State commission, specially charged with the control of the rivers, to which should be submitted everything relating to the rivers of the State.

(34.) The State should pay a portion of the expense of draining swamps and low lands, and in constructing storage reservoirs for the preservation and development of streams and for the abatement of injury to lands by floods.

Very respectfully submitted,

GEO. W. RAFTER,
J. L. KING.

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REPORT OF THE THIRD OR EASTERN DIVISION.

COMPRISING THE WATER SHEDS OF THE HUDSON AND MOHAWK RIVERS.

Commissioner SWEET.

Commissioner FINCH.

REPORT OF THE SUB-COMMITTEE OF THE EASTERN DIVISION.

To the Water Storage Commission:

GENTLEMEN.—We have given to the study and investigation of the flood problem on the Eastern Division assigned to us for examination such attention as the limited time and resources at our disposal permitted, and have the honor to report as follows:

This division includes the Hudson river and all its tributaries. These tributaries have their sources in the Adirondack plateau on the north, in the Catskill and Helderberg mountains on the west and in the Taconic and Green mountains on the east. Our maps are not sufficiently accurate or definite to fix the areas of its water-sheds very closely, nor are their boundaries clearly enough defined by nature to make their areas accurately ascertainable.

The water-shed of the Hudson doubtless exceeds 13,000 square miles, of which about 200 square miles are in the State of New Jersey, about 320 square miles in Massachusetts, and 300 miles in Vermont, leaving about 1,220 square miles, or one-fourth the land area of New York, which is drained by the Hudson river. It is a tidal river from Troy to its mouth, a distance of 150 miles. The difference of elevation with low-water flow and at

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low tide between Troy and New York harbor is about three feet, and at this stage the tide rises about half the height at Albany that it attains at New York. The tidal effect is obliterated at Troy and Albany whenever the river flow reaches 50,000 cubic feet per second, giving the river at Albany a stage about eight and one-half feet above low tide.

The main tributaries of the tidal portion of the Hudson are the Croton, with a water-shed of 350 square miles, Fishkill draining 204 square miles, Rondout creek, including the Wallkill, draining 1,148 square miles, Esopus creek draining 417 miles, the Catskill draining 394 miles and the Kinderhook draining 304 miles. The Croton is being pretty fully regulated by storage reservoirs for the water supply of New York city, and all the other tributaries above mentioned have been studied with reference to their availability for municipal water supplies.

These studies indicate that all these streams are controllable by storage reservoirs, but that their topography is such as to make such development very costly.

Our imperfect reports from the neighborhood of these streams indicate frequent freshets, but none with disastrous effects.

The most serious flood conditions on the Hudson and in the State exist in the upper part of the tidal portion of the Hudson from Troy to Coxsackie, a distance of about thirty miles, where the channel is shallow, crooked and narrow and where the full effect of sudden freshets in the Mohawk and upper Hudson, which come together immediately above the end of the tidal section, are concentrated. The effect of a sudden inrush of water upon this tidal section is obvious. With the ordinary or low stage of flow in this section, the current is intermittently reversed by the tide, and, upon the occurrence of a freshet in the upper tributaries, the water rapidly rushes into this upper portion of the tidal section until a cross-section, slope and velocity are acquired sufficient to carry the freshet flow.

The freshet conditions are greatly intensified in winter and early spring by ice, which necessarily forms more solidly in the quiet tidal section than in the steeper tributaries, and when an

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early freshet occurs, the breaking up of this heavy ice in the upper part of the tidal section, continually retarded by the field below, continually increases in volume along the crumbling upper edge of the latter, and invariably grounds in some shallo or narrow part of this section, creating a gorge or ice dam, to which the most disastrous floods of this part of the river are attributable. These gorges form at various points on this shallow section of the river, sometimes between Troy and Albany, but usually between Albany and Coxsackie, and it is the floods accompanied by these ice gorges that have inflicted the most serious damage upon this section of the river.

The frequency and extent of these ice-gorge freshets is shown on Table No. 1 of the Albany Chamber of Commerce attached hereto, and the damages occasioned in Albany, Troy and the neighboring river towns by the freshets of March, 1902, amounting to over one million dollars, are detailed in Table No. 3 of that report.

When we consider, in addition to this great pecuniary loss from one freshet, the frequency of such floods, the suspension of business and the menace to public health which their interference with the sewer systems occasion, together with the exposure and hardship they entail upon the residents of the flooded districts, it becomes obvious that their abatement or prevention is a grave and urgent public question.

It seems to us extremely doubtful whether with the present irregularity of flow in the Hudson river, there be any practicable means of preventing the formation of these ice gorges in this part of the river, or of removing them by artificial means when once formed. To prevent their formation it would be necessary to have a channel through the ice field throughout this section broken up before a freshet arrives, and the fact that floods are to be apprehended at any time during the four months from December to April, and that the tidal action at low stages of the river would prevent the broken ice from passing rapidly away and that floods come with little warning, means that to prevent ice gorges, the ice in this channel must be continually kept broken up during these months, involving

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a cost of furnishing and operating powerful ice-breaking steamers that would be scarcely permissible, as well as involving the destruction of extensive ice industries; and when we consider that these ice gorges usually pack the river with ice dams for several miles in extent, the impracticability of removing them by mechanical means becomes obvious.

Considerable damage from floods is also reported from some of the other tributaries of the upper Hudson.

It has been suggested that the works undertaken by the State and general governments for the improvement of navigation in the upper tidal section of the Hudson, the filling of the Albany basin and of Island creek in the city of Rensselaer directly opposite this basin may tend to aggravate flood conditions in this part of the river.

We have considered these conditions and deem it certain that the channel improvements by the State and the United States on this section of the Hudson have slightly improved its flood regimen by deeping and rectifying the navigable channel and that the filling of the Albany basin and the Island creek opposite, still leaving the flood cross section larger than the normal flood section of the river in the neighborhood will not appreciably change the flood stage or otherwise injuriously affect flood conditions.

It is doubtless possible to mitigate flood damages on this section of the river by isolating the flooded districts by dykes or levees which would necessitate extensive intersecting sewers, the pumping of the surface and sewer drainage whenever there is a slight freshet in the river, the cost of which would be prohibitive. The only rational treatment we believe to be by storage of the flood flow in the upper tributaries of the stream.

The study of data collected by the State Engineer, in investigating the subject of water storage in the upper Hudson water shed, his surveys and investigations for a barge canal, and the investigations of the United States Deep Water Way Commission relative to water supply for a proposed ship canal, supplemented by our own surveys and investigations, lead us to believe that injurious floods in and above the tidal part of the

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Hudson river are preventable by storage reservoirs, at moderate cost, in view of the vast benefits that would accrue from regulating the flow of the streams tributary to this part of the river.

The flood flow of the river at Troy seldom exceeds 100,000 cubic feet per second, and the low water flow is rarely less than 3,000 cubic feet per second. Of the water shed of about 8,000 square miles above Troy, about 3,500 miles is drained by the Mohawk river and its tributaries, and 4,500 square miles by the upper Hudson and its tributaries.

A study of the conditions attending previous ice freshets in the Albany district, warrants the conclusion that none may be expected with a flow of less than 40,000 cubic feet per second, above which rate of flow the flood problem requires that the tributaries of the river above Troy be regulated.

Assuming, as we shall presently show, that the flow of the upper Hudson may easily be subjected to almost complete regulation, the most serious part of the flood problem is the regulation of the flow of the Mohawk river, because of the greater flood flow of the Mohawk, and because of the scarcity of sites on its water shed where large volumes of water can be economically stored.

The canalization of the Mohawk river, either for a barge canal or a ship canal, with some modifications which seem desirable to secure permanence of navigation, as well as necessary for the flood regulation, would, however, afford a solution of this part of the problem.

The modifications of the barge canal plan deemed essential to secure these important ends, are:

First.— Constructing the Cohoes dam high enough to place the high water surface of the first level above Cohoes at elevation 200, giving the Cohoes guard lock a lift of 30 feet, and locating the first lock above Cohoes near Rexfords Flats with a lift of 30 feet when the level below is drawn down to elevation 170, and making of this level a reservoir of about 5,000,000,000 cubic feet capacity.

Second.— Constructing on the Schoharie Creek at Fort Hunter and at Burtonville reservoirs of about 7,000,000,000 cubic feet aggregate capacity.

These reservoirs, with those provided in the barge canal scheme for water supply, and the dams proposed for the river canalization, would give such control of early floods as to keep them below a rate of 20,000 cubic feet per second, and during the season of navigation to insure a maximum flow below 25,000 feet per second, and would probably insure a minimum flow of over 2,000 cubic feet per second at Cohoes.

Should the canalization of the Mohawk not be undertaken, an equivalent to the modified system of storage outlined above, viz.: Storage at Cohoes and on the Schoharie aggregating 12,000,000,000 cubic feet, and storage on the main stream above Rome, on the Oriskany, on the West Canada and on the smaller tributaries of the river aggregating 8,000,000,000 cubic feet, or a total of at least 20,000,000,000 cubic feet would need to be developed to secure these results.

Earlier studies have shown the practicability of controlling the flow of the upper Hudson above Glens Falls at moderate cost. The upper Hudson between Glens Falls and the mouth of the Mohawk at Troy drains an area of more than 1,700 square miles, and, because of less forest and lake area, lower elevation and more southerly location, doubtless contributes more to winter and early spring floods than does the 2,800 square miles of the water shed above Glens Falls.

The flood problem, therefore, requires a regulation of the flow from this part of the upper Hudson Valley as well as that above Glens Falls.

Its principal tributaries are:

The Hoosick, with 730 square miles of water shed; the Battenkill, with 438 square miles of water shed, and Fish creek, with 210 square miles of water shed.

About 60 per cent. of the water shed of the Hoosick lies in Vermont and Massachusetts, and some storage has been provided near its headwaters in the latter State.

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There is a site about a mile from its mouth where a storage reservoir may be located, developing over 5,000,000,000 cubic feet storage capacity. No other site for large storage seems available on this stream in New York.

The Battenkill, having its source in the Green Mountains of Vermont, has about one-half of its water shed in that State. Water storage aggregating about 5,000,000,000 cubic feet can be provided by dams at Battenkill and Shushan, both located above the principal water powers on the Battenkill. At least 3,000,000,000 cubic feet can be stored on Fish creek by a dam near the foot of Saratoga lake. The Hoosick reservoir would be costly — its cost probably approximating $200 per million cubic feet of capacity. Those on the Battenkill and Fish creek would probably cost not more than half this rate per million cubic feet. Thorough investigations, however, are necessary in order to make approximately correct estimates of their cost.

We believe that no satisfactory regulation of the shallow tidal reach of the Hudson can be effected without the regulation of these tributaries, at least, to the extent above indicated.

The characteristics of the Hudson water shed above Glens Falls, having an area of about 2,800 square miles, have, as we observed above, been pretty carefully studied, and doubtless afford available sites for storing sufficient water for the complete control of the river flow at this point.

Such control necessitates the distribution of the storage reservoirs in such a manner that the maximum flow of the unregulated part of the stream shall not exceed the mean flow sought by regulation, and, that the regulation shall be most beneficial each main tributary containing water-power sites should be regulated with its due proportion of storage, and the small drainage should be conserved by one or more reservoirs on the main stream. The topography of this water shed favors a close approximation to this ideal form of stream regulation.

The principal subdivisions of this water shed are the Sacandaga, with a watershed of 1,040 square miles, the Schroon draining 550 square miles, and the Hudson above the mouth of the Schroon, draining about 950 square miles.

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The run-off records at Mechanicville and Fort Edward indicate the probability that storage to the extent of 18,000,000 cubic feet per square mile of this watershed properly located will afford great regularity in the flow of the stream at Glens Falls, insuring a minimum flow there of over 4,000 cubic feet per second, and, assuming that the storage we have recommended on the Hoosick, the Battenkill and Fish creek to be developed also, we should confidently expect a maximum flow from the Hudson at Troy not exceeding 15,000 cubic feet per second, and a minimum flow there closely appropriating 6,000 cubic feet per second.

The surveys of the Hudson River Electric Company indicate that a storage reservoir, holding 8,000,000,000 cubic feet, can be made at Conklinville, four miles north of the Sacandaga, by raising the present surface of the mill pond there about 24 feet, at a cost that would not exceed $75 per 1,000,000 cubic feet; and we have caused a reservoir site to be surveyed on the West Sacandaga, where a dam located a half mile above the Little Falls of that stream 62 feet high, will store 7,500,000,000 cubic feet at a cost not exceeding $40 per 1,000,000 cubic feet.

A reconnoissance of the east branch of the Sacandaga indicates that about 3,500,000,000 cubic feet can be stored upon it at Griffin and Oregon and the outlet of Lake Pleasant at moderate cost. These reservoirs, aggregating 19,000,000,000 cubic feet capacity, are sufficient for the regulation of this tributary of the upper Hudson.

The due proportion of storage required to regulate the Schroon is about 10,000,000,000 cubic feet. We have studied this watershed with some care, and would suggest some modification of the schemes for storage upon it proposed by Mr. Rafter, as published in the State Engineer's Report of 1895, because both plans proposed by him provide a larger volume of storage than is consistent with the full utilization of the water power of this stream, and because the larger and cheaper plan proposed — that of a single development at Tumble Head Falls — must be executed at one time and necessitates too radical a change in Schroon lake.

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We suggest, first, a dam about a mile and a half above Starbuckville, raising the high water surface of Schroon lake to the elevation 817, creating slight damage and providing over 3,000,000,000 cubic feet storage; second, by a dam near the foot of Brant Lake to provide 1,800,000,000 storage; third, by a dam near the foot of Paradox lake to provide 2,200,000,000 storage; fourth, a dam near Blue Ridge, giving 1,500,000,000 cubic feet; and, fifth, by dams at Loon lake and Hammonds pond, giving 1,000,000,000 cubic feet storage. All these reservoirs aggregate 9,500,000,000 cubic feet storage for this tributary, and we believe this storage can be provided at less than $70 per million cubic feet.

For the North River subdivision of this watershed, we suggest, first, fully developing the storage of Indian river by a dam at the head of the Indian River falls, about four miles below the Indian lake dam, providing 4,000,000,000 cubic feet storage, or with the present development securing storage aggregating 9,000,000,000 cubic feet; second, by dams on tributaries above Indian river to provide 3,500,000,000 cubic feet, and on Boreas river at the outlet of Cheney pond provide 1,500,000,000 cubic feet storage, the whole aggregating 14,000,000,000 cubic feet on this division of the watershed. We estimate the cost of the Indian river storage at $5 per million cubic feet, and the other reservoirs of this division at $75 per million cubic feet.

There would remain on the Hudson river, above Glens Falls, and below the reservoir sites above described, over 400 square miles of watershed unregulated requiring additional storage to the extent of at least 8,000,000,000 cubic feet to complete this storage system, which may be provided as follows: One-half the deficiency, or 4,000,000,000 cubic feet, by the reservoir recommended in the State Engineer's report of 1895, by Mr. Rafter, to be located at Hadley; and 4,000,000,000 cubic feet by a reservoir created by raising the State canal feeder dam two miles above Glens Falls, about 45 feet, or to the elevation 333.

The cost of these two reservoirs may approximate $100 a million cubic feet. The system of regulating reservoirs for the

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upper Hudson, located as we have suggested, would not only secure the desired regulation of the lower Hudson, but would provide like regulation to all its upper tributaries, thus conserving in the highest degree the potential energy of the stored water for the development of power on the tributaries as well as on the main stream, and would benefit navigation by providing ample feed water for the proposed enlargement of the Champlain canal, and by raising the minimum low water stage of the Hudson river in the shallow portion below Troy more than one foot.

E. SWEET,
GEO. R. FINCH.

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REPORT OF THE FOURTH OR NORTHERN DIVISION.

COMPRISING THE WATERSHEDS OF LAKE CHAMPLAIN AND OF THE ST. LAWRENCE, BLACK AND SALMON RIVERS.

Commissioner BOYD.

Commissioner BOND.

To the Water Storage Commission:

GENTLEMEN.—We have studied the problem of flood prevention on the Northern Division as far as the time and data available would allow and submit the following report thereon:

The principal streams in the Northern Division arranged in the order of their drainage area are as follows:

Black river and tributaries	1,930
Oswegatchie	1,609
Raquette	1,240
St. Regis	910
Grasse	637
Saranac	628
Salmon	480
Big Chazy	299
Salmon (Lewis and Oswego counties)	285
Chateaugay (in New York State)	199
Trout (in New York State)	129

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The sources of all these streams are in the Adirondack plateau or in the adjacent foot hills. The Salmon and Black flow west into Lake Ontario, the Oswegatchie, Raquette, St. Regis, Grasse, Salmon(N), Big Chazy, Trout, and Chateaugay flow northerly into the St. Lawrence river, and the Saranac and Ausable northeasterly into Lake Champlain.

Black River.

This stream rises in numerous lakes in the western part of Hamilton county; flows southwest through Herkimer county, thence northwesterly through Lewis and Jefferson counties, entering the east end of Lake Ontario at Black River bay.

The drainage areas of the main stream and its principal tributaries are as follows:

Black river, at mouth	1,930.2
Black river, at Carthage	1,812.2
Black river, above mouth of Moose	463.0
Beaver river, at mouth	447.5
Moose river, at mouth	415.5
Deer river, at mouth	102.0
Independence creek, at mouth	98.8

The head waters of the Black river and its eastern tributaries are in the Adirondack plateau, and drain a large number of lakes and ponds. Above Lyons Falls the watershed is mountainous and mostly timbered, large portions belonging to the State Forest Preserve. At Lyons Falls the river flows over a limestone cliff with a fall of 67 feet, forming a valuable water power. From the foot of the falls at Lyons Falls to Carthage, the valley of the river varies from one-half to six miles in width, the stream is sluggish and has been canalized for navigation. From Carthage to Watertown and thence to Lake Ontario the river flows over numerous limestone ledges, furnishing valuable water power. The total fall from the State dam at Carthage to Lake Ontario is 477 feet.

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A large amount of detailed information regarding the water powers and mills on the Black river is given in the report of the Engineers on Deep Waterways published by Congress in 1900.

A local flood committee, appointed by the mayor of the city of Watertown, has brought the record up to date, covering the Black and its principal branches, and reports the data to be as follows:

Number of dams furnishing water power.....	44
Total horse power of water wheels in use	71,133
Steam power used in connection with above	6,037
Valuation of establishments	$12,302,100
Value of annual product	15,101,440
Number of hands employed	5,349

Gauging of the flow of the Black river at Watertown made under federal or State control have been taken from February, 1897, to date.

These gaugings show that the summer flow is from 800 to 1,000 cubic feet per second, and the flood flow from 28,000 to 30,000 cubic feet per second.

A natural consequence is that mills on the Black river are very short of water in the summer, while the spring floods cause heavy damage to dams, flumes and mills.

The State has built several reservoirs in the head waters of the Black river for the storage of water for feeding the Black and Erie canals, and for compensation water for that taken for canal purposes. Additional storage can be secured at most of the State reservoirs by raising the dams and dikes, but there are few available sites for new reservoirs on the head waters of the Black or Moose rivers.

The following table from the United States Deep Waterways Report gives the data regarding the State reservoirs on the Black river and its branches.

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Name.	Capacity in cubic feet.
White lake	64,000,000
Chub lake	35,000,000
Sand lake	200,000,000
Woodhull lake	438,000,000
Canachagala lake	56,000,000
North lake	676,000,000
South lake	350,000,000
Twin lake	60,000,000
Fulton Chain lake	800,000,000
Forestport lake	300,000,000
Beaver flow (estimated)	800,000,000
Total	3,779,000,000

In formation gathered by Watertown committee shows the following favorable sites for storage reservoirs on the tributaries of the Black river:

On Beaver river, at the present State dam, by raising the crest of the new dam now being built ten feet, and at Beaver lake by raising the present dam.

On Independence river, about four miles above its junction with the Black river, and at what is known as Balsam Flats, in Township 3 of John Brown's tract.

On the South branch of Moose river, at what is called Rock dam, in Township 4 of Moose River Tract, also on the north branch of the Moose near its junction with the Fulton Chain branch.

The United States Board of Engineers on Deep Waterways caused surveys, plans and estimates to be made for a storage reservoir on the Black river, extending from Carthage to Lyons Falls. As shown by the report of that board, by building a dam 48.5 feet high at Carthage, a reservoir would be formed covering 75 square miles, with a capacity of 57,000,000 cubic feet, at an estimated cost of $5,712,200.

The proposed deep waterway reservoir was designed to store a volume of water equal to a depth of 13.50 inches over the entire water-shed of the Black river above Carthage, and to

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furnish a constant supply of 2,200 cubic feet per second to the Black river below Carthage, in addition to the water necessary for the proposed deep waterway at Rome, during the canal season.

If the proposed reservoir were built it would furnish a constant water supply for power greatly in excess of the summer flow of the Black river and would prevent disastrous floods in that river below Carthage.

For a proper regulation of the floods in the Black river it is probable that a reservoir storing a volume of 26,349,578,500 cubic feet, or 6¼ inches on the entire water-shed would be sufficient. For such a reservoir a dam thirty-one feet high would be required at Carthage.

The deep waterway project is cited to show the possible storage on the lower Black river.

Reference is made to the appended report of the Watertown flood committee for detailed information regarding the damage done to property on the Black river by floods.

REPORT TO THE NEW YORK STATE FLOOD COMMISSION ON THE BLACK RIVER VALLEY AND ITS INTEREST.

The Black river rises in the heart of the Adirondack forest, in the westerly part of Hamilton county, and passes through Herkimer, Oneida, Lewis and Jefferson counties in its course to Lake Ontario. The length of the portion bearing the name of Black river from its source at Canachagala lake to its mouth at Black River bay following the course of the river is 112 miles, though the source of the Moose river, its largest tributary, is 20 miles farther into the woods. The air-line distance from the source of the Moose river to the mouth of the Black river at Dexter is eighty miles.

The area of the country which flows its waters into the Black river is very nearly 2,000 square miles (it is given in the report of the Deep Waterways Commission as 1,903.2). From Carthage to the mouth of the river, a distance of a little over 20 miles, the general width of the area is only 6 or 7 miles, while above Carthage it widens out, giving the greater part of the catch-

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ment area in the Adirondack district. The greatest width of the area is 45 miles and the length above Carthage about 60 miles.

Beginning at Lake Ontario the river falls 123 feet from the west line of the city of Watertown, it falls 112 feet in passing through the city, and 477 feet from the top of the State dam at Carthage to the lake level at Dexter; there is a total drop of 69 feet at Lyons Falls, while the surface of the Eighth lake on the Fulton Chain is 1,556 feet above Lake Ontario, and that of the south branch reservoir on the Black river proper above Forestport is 1,772 feet above Lake Ontario. The surface of Lake Ontario is 247 feet above mean tide level.

From the above figures, which have been gathered largely from the Deep Waterways Reports, it can be seen that the water-shed has a rapid fall, especially in its upper portion, which has the effect of sending down the waters gathered from rainfall or melting snow much more rapidly than would be the case if the country were more nearly level.

Quoting from the Deep Waterways Report of 1898:

There are 20 dams on the Black river from Dexter to Lyons Falls, inclusive. There are 93 different establishments doing business.

The total horse power of water wheels in use is...	54,050
With a total horse power of steam used in connection of	1,482
Valuation of the property of these establishments,	$7,836,100
Value of the annual product.....	10,887,170
Number of hands employed in mills.....	3,900

A detailed statement of each mill or establishment above mentioned is given in the Deep Waterways Report in Table 128, in Volume 2, beginning at page 846. In order to bring this report down to date, a copy of the statements given in the above table, as to power, valuation of plant and of product, number of men employed, etc., was sent to each establishment with the request that it should be corrected if any of the conditions had

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been changed and returned to this committee. In this way it was found a very few small shops had been discontinued, a number of new powers had been built and quite a number had increased their capacity and their business. Following is a summary of the results, to which is also added a number of mills lying up the Moose and Deer rivers, that were not included in the Deep Waterways Report:

Number of dams furnishing water power.....	44
Total horse power of water wheels in use.....	71,133
Steam power used in connection with the above..	6,037
Valuation of establishments.....	$12,302,100
Value of annual product.....	15,101,440
Number of hands employed.....	5,349

With all the above-described property located along the Black river in convenient proximity to receive power from its waters, there are many points exposed to the action of floods, and in the past some notable examples of damage from floods have been sustained.

The Black river above Forestport is the source of one of the large feeders of the Erie canal, and this area of 268 square miles has been quite thoroughly provided with storage reservoirs to maintain the flow of water throughout the season for canal uses; this provides for the delivery of 11,000 cubic feet per minute, or about 16,000,000 cubic feet per day to the canal at Rome during the canal season, but since this diversion does not occur during the winter months, nor during the months of spring when the floods usually come, it follows that the only benefit we receive from this is the partial immunity from floods due to the filling up of these reservoirs, and while their capacity as per the State Engineer's Report is 1,220,155,000 cubic feet, and does, as far as it goes, exercise a beneficial influence on the action of floods at Forestport. It in reality only serves to illustrate to those living farther down the valley what might be accomplished by a further extension of such a system, in the way of storing and holding back the waters of the spring floods.

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A record of the flow of the Black river since February, 1897, has been kept at Huntingtonville, about a half mile above the city of Watertown, by daily gaugings where the entire river passes over a dam, built by the water commissioners of Watertown to obtain a settling basin for their water supply. From this record we have the actual average daily and monthly flow expressed in cubic feet per second, the daily record can be found in the report of the State Engineer for the year 1901 at page 366, with a hydrograph following; also the daily gauge heights are given in Bulletin No. 36 of the United States Geological Survey at page 192 up to the beginning of the year 1900, and Plates 101 to 105 of the atlas accompanying the Deep Waterways Report are devoted to the subject of the flow of Black river. Plates 103, 104 and 105 give the theoretical flow from 1887 to 1897 by comparing the catchment area of the Black river with the catchment area of the Hudson river, and assuming that the run-off would be in proportion. Plate 102, however, gives the comparative measured run-off of the Black river and the Hudson river expressed in inches on their respective catchment areas for the years 1897, 1898 and 1899 up to June. An inspection of this plate shows that the floods of the Black river exceed those of the Hudson river 17 to 30 per cent. in March and April, 1897, 27 per cent. in March, 1898, and 45 per cent. in April, 1899. This is due to different conditions of the two water-sheds, which, although they lie adjacent to each other, vary considerably in steepness of slopes and length and levels of tributaries.

Mr. George W. Rafter, civil engineer, and at present one of the members of the Flood Commission of the State of New York, is the author and compiler of much of the data given above, and it will doubtless be very plain to him why the Black river floods are greatest. The damage by floods in the past is somewhat difficult to explain in its full measure; many mills have to be shut down when the floods come because the high water either rises and covers their floors, or rises higher below than it does above their dams, and thus stops the proper working of the wheels. In 1896 the spring flood broke away some of

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the dams above Forestport, which added the reservoir volume to the already over-high flood level of the river, and much damage to the water powers and mill property was the result.

Following is a statement of some of the losses that have occurred; the dams and mills are numbered from the mouth of the stream up:

At Dexter, dam No. 1, mill No. 1, reports from the flood of 1896 the breaking of their boom and the carrying away of a large quantity of logs which were lost in the lake, amounting to thousands of dollars. Mill No. 2 reports a loss from the flood of 1869 of $1,500 in lumber and docks carried away.

At Brownville the flume carrying the water on the north side of the river was carried away by the flood of 1896, and had to be rebuilt and the following year the same thing occurred on the south side of the stream, all of which necessitated large outlays of money for rebuilding and great loss to the mills in business while lying idle.

At the Ontario Mill, dam No. 3, mill No. 14, a portion of the flume wall was carried away by the flood of December, 1901, causing a large expense for repairs and the loss of time.

At dam No. 5, mill No. 16 (No. 4 mill), in the spring of 1890 the flume, the water wheels and the entire back part of the mill was carried away by the flood and the entire season was consumed in rebuilding; this was a loss not only of the buildings and machinery, but an entire season's business.

At dam No. 6 (the lower dam in the city of Watertown) the bulkhead and flume were carried away in 1896, and the city mill (grist mill) was carried away bodily. All business at the south end of this dam was deprived of power for several months.

Dam No. 7 was carried away by the flood of 1869, and left the business adjacent to Beebee's Island without power for the greater part of the season; at this time the water supply of the city was pumped by power from this dam and had to be supplied by steam while the dam was out. The firm of A. H. Herrick & Son report a loss of $8,000 at this time.

The New York Air Brake Co., report that they have to shut down their water power from one to two weeks each year on

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account of flood water in the river; and the Watertown Electric Light Co. have been obliged to add an auxilary steam plant, on account of back water on their wheels at flood time, which depletes the power so that they are unable to do the usual lighting of the city by water power.

At dam No. 8, at Factory square, from $1,500 to $2,000 was spent in repairing flood damages recently, and in 1869, power No. 45, then called the Phoenix Mill, was entirely swept away, together with the bulkhead and flume and the entire season lost to business besides the cost of rebuilding; at this dam the mills are also obliged to shut down about two weeks each year at flood time on account of back water.

At dam No. 10, Marble Co., in 1896, bulkhead and flume carried away and $1,500 to $2,000 spent in replacing it and have to shut down each year on account of back water.

At dam No. 11, mill No. 55, Watertown Water Works, there is serious obstruction each year at flood time on account of back water.

On dam No. 12, mill No. 56, Watertown Paper Co., mill just below Black River village, one whole side of flume was carried away in flood of 1900, stopping work in mill for a number of months, and costing a large sum for repairs.

On dam No. 13, at Black River village, the stone flume wall of the Jefferson Paper Co.'s mill was carried away by the flood in the spring of 1896, stopping the water wheels for several months and costing considerable for repairs.

At dam No. 14, mill No. 66, Taggart's Paper Co., felt mills, flood water raised on mill floor in 1896 and stopped work; have to shut down each year when water is highest.

Dam No. 15, mill No. 67, Great Bend, part of flume carried away in 1879. Flood of April, 1883, flood water moved the flume out of place and had to be rebuilt, and about four weeks lost time. In 1896, flood water over pulp mill floor, lost about 20 feet stone bulkhead wall and 40 feet of mill wall next to the river. December, 1901, flood raised unusually high and carried away a quantity of pulp wood. They have to shut down nearly every year on account of back water.

Dam No. 18, mill No. 71, Island Paper Co., Carthage, N. Y., flume wall carried away by flood in spring of 1900, lost water power for six months and cost of repairing wall.

Dam No. 19, State dam at Carthage, the powers on this dam are much interfered with back water from floods.

On Deer river, which is the first large tributary on the south side of the valley. At Deer River village, in 1890, the flumes were carried away and portions of the mill walls; and 1896, there was further damage to the mills, and the highway bridge was carried away.

At Copenhagen, on the Deer river, in 1890, Ward's mill and Twining's mill were entirely washed away by the flood, at a loss exceeding $10,000. Campbell's mill was also damaged by the same flood and store house and lumber storage owned by Carey was entirely washed away. In the flood of 1901, the highway bridge above Copenhagen was carried away with its abutments.

At New Boston, in 1890, the dam was carried away and mill damaged by undermining its foundations.

On Independence river, a large tributary on the east side of the Black river, Crawford's lumber mill was carried away by the flood of December, 1901; also four public bridges and two mill dams, estimated loss about $10,000.

On the Moose river the flood of December, 1901, was disastrous in many ways and besides the damage to dams, mills and bridges, carried away some three million feet of logs and scattered them over the flat country between Lyons Falls and Castorland.

In nearly all the mills along the Black river and its tributaries, it is found necessary to shut down for from one to two weeks at flood time in the spring, in fact it is the opinion of this committee that a conservative estimate of the loss in the Black river valley on account of floods reaches at least a half million dollars each year, and it is believed that this fact alone, is worthy of the serious attention of the flood commission, and the State government; and calls for the putting forth of all reasonable efforts to avert it.

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Possible sites for storage. Recommendations for storage reservoirs have been made by those who know the ground, as follows:

On the Deer river above Copenhagen the valley of the river and the high banks afford an opportunity for building a dam that will store a large quantity of water, and about three miles above New Boston is an excellent opportunity for building a small dam that will give a large result in storage capacity.

On the Beaver river the reservoir created by the new dam now in course of construction, which is to supplant the old dam a mile farther up stream, can be raised ten feet higher, offering a storage capacity immensely larger than is now realized, and this without damaging the land or timber to any great extent farther than is already done or provided for in connection with the present Beaver river reservoir.

At Beaver lake is an opportunity to raise a dam that will store the water tributary to the lake and also catch the overflow from the present reservoir.

On the Independence river one dam is recommended in the town of Watson, about four or five miles above its junction with the Black river and one at what is known as the Balsam Flats, in town No. 3, of John Brown's tract. The latter will store a large amount of water on the upper part, while the lower one will take the waters of the lower portion of the watershed and catch the overflow from the one above.

On the Moose river, one the south branch a reservoir is recommended on township No. 4 of the Moose River tract, with a dam at what is called Rock dam on the United States Geological Survey chart, Old Forge; also on the north branch of the Moose, it is thought a reservoir can be made in town No. 7 of John Brown's tract, by placing a dam near the junction of this stream with the Fulton Chain branch.

The following letters from Mr. Crawford, on the Independence river, and from Mr. Gould on the Moose river, are of interest as showing local conditions:

D. M. ANDERSON, *Chairman:*

MY DEAR SIR.—Answering your inquiry of the 30th ult., I have to say regarding the Independence river. That this is a rapid stream, estimated to be about sixty miles long from source to Black river, having several large feeders and draining many lakes and ponds.

The damage done during the flood of December 14th, last, was the greatest in amount of any during my knowledge of the stream about thirty-two years. Four bridges were carried away and two mill dams broken, and my saw mill of 5,000,000 capacity entirely destroyed. The monetary loss is difficult to estimate, as the bridges have not been rebuilt. The mill damage was fairly $5,000, to say nothing of repairing and rebuilding dams. It is safe to say, however, that $10,000 would no more than make good the loss by that flood.

As to reservoirs, one at Wilson's, the place shown to you, I think would be the most useful of any that could be located. A dam at the head of the falls of the Independence flowing the Third Creek flats would store a large amount of water. The land damage in either case would not be great as the land that would be flooded is now uncleared and the timber standing thereon not valuable, except for fuel.

Very truly yours,

L. CRAWORD.

LYONS FALLS, N. Y., *August* 11, 1902.

MR. D. M. ANDERSON, *Chairman, Watertown, N. Y.:*

DEAR SIR.— In relation to recent damages caused by floods. There is more or less damage done every year on Moose and Black rivers by floods or freshets. This is caused by the lands which the south branch of Moose river drain (some 200 square miles) being mountains, and the water runs off quickly. The most serious flood which has occurred on Moose river in many years was in December, 1901. At this time more or less damage was done to all of the mills, and some 3,000,000 feet of

logs was taken out of the Moose river and scattered on the flats between Lyons Falls and Castorland. In my opinion the most available site for a reservoir is on the south branch of the Moose river, at what is called "Natural Dam," situated on township No. 2 of Moose river tract. A dam built there would make a reservoir which would not only prevent floods, but would also be of great benefit tc the water powers below on Moose and Black rivers as far as Dexter.

Yours truly,

G. H. P. GOULD.

Other numerous opportunities for reservoirs than those above named exist along the streams, and will be readily found upon a closer examination of the country.

The reservoirs herein recommended can mostly be built without flooding extensive or valuable tracts of timber land, and the State ownership of lands in the Adirondacks forests brings the subject easily under the control and management of the various departments of the State government.

Respectfully submitted,

D. M. ANDERSON, *Chairman.*
W. O. BALL,
G. H. P. GOULD,
GEORGE DRYDEN,
FRANK A. HINDS.

Oswegatchie River.

This stream has its source in several lakes and swamps on the Adirondack plateau, in the southern portion of St. Lawrence county. The main stream is the outlet of Cranberry lake and flows in a general northwesterly direction, entering the St. Lawrence river at Ogdensburg. Indian river, one of the principal tributaries of the Oswegatchie, rises in Indian and Bonaparte lakes, flows to and through Black lake and joins the Oswegatchie at few miles above Ogdensburg.

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Drainage Area of Oswegatchie River.

East branch	358
West branch	272
Oswegatchie, above Galilee	1,033
Indian river	544
Oswegatchie, below Indian river	1,577
Oswegatchie, at mouth	1,609

The flow of the Oswegatchie at Ogdensburg varies from 614 second feet at low water to 15,500 second feet during the spring floods.

Water power is developed by 26 dams on the Oswegatchie and its branches, and is used mainly in lumber and paper industries, at various points.

Water is stored in Lake Bonaparte by private parties and sold to mill owners down the Oswegatchie and Indian rivers.

Cranberry lake, with a water surface area of 12.8 square miles, would furnish additional storage if the present dam were raised a few feet. Black lake with a water surface of 17.2 square miles is virtually an enlargement of Indian river, and greatly aids in regulating the flow at Ogdensburg, offering a chance for additional storage at a reasonable cost.

Additional storage can be secured at Lake Bonaparte by raising the present dam.

As Cranberry lake and Lake Bonaparte are surrounded by low-priced land, the cost of additional storage of their waters would not be great, while the cost of increased storage in Black lake would not be excessive. Small storage reservoirs could also be built on Indian river at Sterlingbush about eight miles below the outlet of Lake Bonaparte and at the village of Theresa. Storage reservoirs can be formed on the West branch of the Oswegatchie at a chain of lakes known as Rock, Trout, Long and Round ponds; on the middle branch about 20 miles above its junction with the west branch at a point locally known as the "Alder Beds."

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The appended reports from the flood committees at Ogdensburg and Gouverneur give detailed information regarding the floods on the Oswegatchie river and its branches.

OGDENSBURG, N. Y., *September* 13, 1902.

DEAR SIR.— The undersigned were appointed by Mayor Hall as a committee to draft and submit to the Water Storage Commission such facts as could be gathered in regard to the damage done by floods along the Oswegatchie river.

We beg to submit herewith our report.

While we have not had a great amount of time at our disposal we can assure you that every statement of fact included in the report is conservatively made.

Mr. Spratt will probably be our representative in case a meeting of the full commission is subsequently held, as mentioned in your letter of July 17th last to Mayor Hall.

Thanking you, and, through you, Mr. Boyd for the very courteous attention given to the suggestions of our citizens when you were in Ogdensburg, we remain,

Yours respectfully,

ALRIC R. HERRIMAN,
HARVEY L. JONES,
THOMAS SPRATT.

HON. EDWARD A. BOND,
State Engineer and Surveyor,
Capitol, Albany, New York.

To the Honorable, The Water Storage Commission:

We, the undersigned committee appointed by Hon. George Hall, mayor of the city of Ogdensburg, to investigate and report to your honorable body the causes of the overflow of the Oswegatchie river from Gouverneur to the River St. Lawrence, in the city of Ogdensburg, and the Indian river from Theresa to the head of Black lake, respectfully report:

That we have made careful investigation with a view of obtaining such information as we could as to the causes of the overflow of said rivers and the damage occasioned thereby.

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It will be seen by an inspection of the map that the Oswegatchie rises in Cranberry lake and its tributaries, and flows in a northerly direction until it empties into the River St. Lawrence at the city of Ogdensburg. It might be added that the westerly branch of the Oswegatchie river rises in Lewis county and empties into the main branch in the town of Edwards and is a very heavy feeder of the easterly or main branch of said river.

At the foot of Black lake, about four and one-half miles southerly from the mouth, the waters of the Indian river and the Oswegatchie mingle. The Indian river rises in what are known as Bonaparte and Indian lakes in Lewis county, flows in a northerly direction and empties into Black lake, at its head about one mile northerly of the village of Rossie.

The country through which these rivers flow was at one time very heavily timbered, but in later years the timber has been removed from a greater portion of the territory, and at the present time there is but little covering in the way of foliage, timber, etc., to retard the effect of the sun or rain in melting the snow and ice, so that a great change has come about with reference to the carrying away of the snow and ice in the territory drained by these waters.

In early years the snow melted gradually and the rise of the water was slower than in later years. Since the timber has been removed from the territory in question the sun operates more readily and effectively upon the snow and ice, and the result is a very sudden rise of the water and immense quantities are precipitated through both rivers into the St. Lawrence at Ogdensburg and frequently great damage is done to the property adjacent to and along said rivers.

Where the Oswegatchie flows into the St. Lawrence the river itself is narrow and is confined by wharves, buildings, canals and flouring mills. A portion of the harbor in the city, known as the upper harbor, is formed partially along the right and left banks of the Oswegatchie and is used each year in the anchoring and laying up of vessels. Bill, Bell & Company's Flouring Mill, the Ogdensburg Roller Mills and the New York Central

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and Hudson River Railroad Company use their wharves constantly, the mills for the purpose of elevating grain from vessels into their mills, and the railroad company to transfer freight and passengers from Canada and river points to their warehouses and passenger depots, and in the transfer of cars from car boats to their tracks by means of the car slips on the westerly side of the harbor.

About one-fourth of a mile from the mouth of the river a dam was constructed many years ago and is still maintained. There is a fall of about 11½ feet, and the power derived from the storage of this water supplies almost the entire manufacturing industry of the city, and in fact is the only water power we have.

Between the level of this dam and the point where the waters of Black lake and the Oswegatchie river meet there is a fall of 15½ feet, so that when the water rises in the spring it comes with great force down to the city of Ogdensburg, carrying with it immense quantities of ice, and almost invariably forming ice jams below the dam. The result is the sudden raising of the waters of the Oswegatchie, the flooding of adjacent lands, and imminently endangering the public and private property in the vicinity, notably the steel bridge crossing the Oswegatchie at this point, which is a very costly structure, the city water-works, which supply the city and the New York State Hospital with water, the shipping in the harbor and the various mills, docks and manufacturing establishments along the west bank of the river.

With certain weather conditions — for instance, a large amount of snow and ice, a heavy warm rain and a strong south wind, not only the dam itself, but the city water-works should be almost inevitably greatly damaged, if not entirely destroyed, and the direct and indirect public and private loss resulting from such an occurrence would be almost incalculable.

For the past number of years great precaution has had to be taken by the people of the city to avoid the serious consequences above indicated, but in spite of their endeavors it has caused serious damage in the past, and we firmly believe will cause serious damage and disaster in the future, unless some effective

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remedy is adopted. The value of the property which will be injured is hard to estimate, but we can readily see that under certain circumstances likely to arise at least one-half million dollars' damage might be done. To illustrate, we have made careful inquiry and investigation as to the damage done by the overflow of water and ice in the spring of 1902, and we can conservatively say that, with the damage to the docks and wharves between the bridge and the River St. Lawrence, during the spring, and to the dam and bridge, the piers, bulkheads, sluiceways and penstocks, it amounted to at least the sum of $15,000.

About seven miles southerly from the city of Ogdensburg is situate the village of Heuvelton, where there is another dam and water power. There is a considerable rise from the junction of Black lake and the Oswegatchie river to the dam at the village of Heuvelton. In the spring of 1902, owing to the overflow of water and ice, said dam was partially destroyed and carried away causing damage exceeding the sum of $3,500.

About five miles above Heuvelton is situated the village of Rensselaer Falls, where there is another water power and dam. The overflow of water in the spring of 1902 carried away part of the dam, injuring the dam and the property adjacent in the sum of $4,000. There is a fall of about eight feet from Rensselaer Falls to Heuvelton.

The next falls above Rensselaer Falls is Coopers Falls, a distance of about four and one-half miles. There is only a natural dam at this point. No artificial dam has been erected.

At a distance of about twenty-four miles above Coopers Falls is situate Smith Falls. This distance of twenty-four miles might be termed "still water," as there is no perceptible fall. This part of the river is bordered by low-lying, rich meadow lands, which are overflowed in the spring and covered by injurious deposits of refuse matter, sawdust, etc.

At the village of Rossie on the Indian river there is a very important waterfall and power. At one time there was established there an iron furnace, grist mill, saw mill and foundry, and the village was a very thriving one. A dam was constructed many years ago at large expense, but on account of the

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overflow of water a portion of the dam was carried away and was rebuilt by the Rossit Iron Company, at a very large expense, we think at a cost of at least $10,000. Although the dam has been repeatedly well and substantially constructed the strength of the water has forced out a portion of the dam, and the result is that the water power at that place is substantially destroyed and at the present time no great value can be placed on this water power or the industries connected therewith.

About two miles above Rossie there is what is known as the Hall Rapids. These rapids have been cut down, which fact causes the water to flow from the direction of Theresa very rapidly to the village of Rossie, and thence into Black lake.

Your committee believes that the only safe thing to do in order to protect this property in the city of Ogdensburg, is to construct a substantial and proper dam at a point known as the Eel weir, a little below the junction of the Indian river or Black lake and the Oswegatchie river. This would cause a reservoir to be made of Black lake and the water could be held back and allowed to flow gradually through the Oswegatchie river into the St. Lawrence in such a manner as would protect the life and property of the citizens of the city of Ogdensburg.

Your committee also recommends that the present reservoir at Cranberry lake be enlarged by the raising of the dam and the putting in of proper gates and bulkheads, so that the water flowing from said lake shall be under complete control and may be drawn off gradually.

Your committee further suggests that a reservoir be constructed near Harrisville on the west branch of the Oswegatchie river for the purpose of controlling the flow of the water in the early spring and preventing the same being precipitated into the easterly or main branch at a time when the river is overflowed by melting ice and snow and heavy rains.

All of which is respectfully submitted.

Dated Ogdensburg, N. Y., September 13, 1902.

THOMAS SPRATT,
ALRIC R. HERRIMAN,
HARVEY L. JONES,
Committee.

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To the Honorable State Water Storage Commission, Albany, N. Y.:

GENTLEMEN.— The local committee selected at the citizens meeting here, to assist your commission in the gathering of information as to floods and freshets on the Oswegatchie river beg to report to your Honorable Commission that the territory they have endeavored to cover includes the Oswegatchie river from the headwaters of its branches to and including the village of Natural Dam, located two miles below Gouverneur.

The Oswegatchie river from Gouverneur up to the sources of its three branches is a constant succession of falls and rapids; so rapid is the fall, that on one section of the river there are in a distance of eight miles, nine distinct waterfalls, with an aggregate head or fall of 465 feet, and this without taking into consideration the swift water, and minor rapids, between the larger falls; this particular section is above the village of Harrisville, on the "middle" branch of the river, in a country that is being rapidly denuded of its timber and foliage, so that in a very few years there will be nothing left to prevent the rapid melting of the snow and ice and the consequent disastrous floods and freshets, unless there shall be reservoirs constructed to hold back the waters until such time as they can be let off with safety. Located on that part of the river covered by this report there are mills and factories, representing an investment of capital in excess of two million dollars, and in the villages and hamlets about these various industries and largely dependent on them for their existence is a valuation of probably as much more; practically all of this property is necessarily so situated that it is extremely liable to damage from the river freshets, and in fact has suffered to a serious extent from this cause; this has been the case more especially within the past eight or ten years, due very largely, in the judgment of your committee, to the cutting off of the forest, and the consequent greatly increased flow of water in the river during the freshet time in the spring of the year; it is the opinion of various reliable men thoroughly familiar for years with the river in its various stages that during the last

eight or ten years the high water period of spring has been shortened at least one third from what it was when the melting of the snow was retarded by the protection afforded it from the action of the sun by the foliage and timber that has been taken off; the same quantity of water flows off now as in the past, but so much more rapidly and in greater volume, owing to the causes mentioned, that there is more occasion for fear of damage each year, and the villages, and their industries, that a few years since were located with a reasonable margin of safety from damage by floods are now in a fair way of being swept away if nothing is done to check this increased flow of the river in its shortened freshet season. There is now at the head of the north branch of the river quite a large reservoir at Cranberry lake, which has undoubtedly prevented a very great amount of damage in holding back the waters of that branch; the dam at the outlet of this reservoir should, in the judgment of your committee, be strengthened and its height increased two or three feet; this would add greatly to its capacity and tend very materially to decrease the danger from freshets on the river to the junction of the stream with the south branch, at a point some eight miles above Gouverneur; the cost of raising and strengthening this dam would not be a serious item, and as the question of damages to be paid for lands flowed would apply only to the land affected by the two or three feet additional depth of water in the lake, the entire amount involved would seem insignificant, in comparison with the value of this additional safeguard against damage to life and property the entire length of the river; there has just been completed a railroad into the territory draining into the Cranberry Lake reservoir, and a large sawmill, now in course of construction, will within the next five years lumber off some 16,000 acres of woodland, all within the drainage area of the lake; in addition to this there are a number of smaller lumbering operations actively at work in the same locality, so that in the judgment of your committee, there will be in excess of 30,000 acres of woodland in the Cranberry Lake section, from which the timber will be taken off within the next five years.

On the South branch of the river, and its Middle branch, and West branch extensions, the conditions are even worse than on the North branch; the descent of the river here is more rapid and there is no reservoir; the timber is being taken off in this territory quite as rapidly as on the North branch, and there is the most urgent necessity for the establishment of two reservoirs in this section; one to be located on the West branch, and one on the Middle branch; there is on each of these branches most favorable storage reservoir locations. On the West branch, at a point about 21 miles above its junction with the Middle branch, is a chain of lakes, known as Rock, Trout, Long and Round ponds; at a very reasonable cost for a dam a reservoir covering an area of about 8,000 acres could be had at this place. On the Middle branch, and about 20 miles above its junction with the West branch, begins what is known as the "Alder Beds," a most satisfactory site for the economical location of a dam for the establishment of a reservoir, with an area of some 7,000 acres, about one-fifth of which would be State lands; the length of the dams at the two locations suggested would not be in excess of 200 feet; in each case the natural conditions are such, as to favor the most economical construction; the lands that would be flowed are of comparatively small value when the timber has been taken off, and in some instances your committee has been advised, by the parties interested, that they would so arrange their operations, as to very soon remove the timber from that portion of their territory, which would probably be flooded by the establishment of the suggested reservoirs if these sites should be selected.

The area of farming land on the Oswegatchie river above Gouverneur which is annually overflowed is, approximately, 10,000 acres, and each succeeding year makes this overflow more dangerous, and a great burden on the owners and occupants of the lands; fences are swept away, deposits of refuse are left on the land in some localities, while in other places the soil and trees have been washed off and carried away.

It has been difficult to obtain accurate information as to the actual damage sustained by the action of the freshets over as

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extended a period as your committee would have desired; but, in their judgment, after a careful scrutiny of the facts, this damage has been in excess of $50,000, during the two years last past, in the territory covered by this report.

Your committee desires particularly to call to your attention the fact that the great change in the duration and violence of the flood seasons on the river, due to the removal of the timber and foliage from the territory drained, have within a comparatively short time created greatly changed conditions on the stream, as regards the safety of life and property; the dwellings and factories that when built were located with a due and proper regard for safety, and freedom from damage, are no longer safe; on the contrary, it is a question of only a very few years, and a few more thousand acres of timber being cut off, when dwellings, factories and mills must be walled about or abandoned if some such measures as contemplated by the creation of your honorable commission is not carried out.

All of which is respectfully submitted.

ANGUS DONALD.
O. J. DAVID.
T. J. WILBER.
W. T. CLARK.
IRA C. MILES.
H. G. ALDRICH.
G. S. CONGER.

Dated at GOUVERNEUR, N. Y., *September* 27, 1902.

GOUVERNEUR, N. Y., *October* 1, 1902.

Hon. EDWARD A. BOND, *State Engineers Office, Albany, N. Y.:*

DEAR SIR.— Herewith you will please find the report of our committee, on the condition of affairs on the upper Oswegatchie river, which I trust will be of some help to your commission even if somewhat late.

We shall be pleased to have an opportunity to be represented by one or two of our committee before your commission at the

proper time, if you will kindly advise us of the date of your meeting.

Yours very truly,
ANGUS McDONALD.

Hon. CHAS. L. BOYD, *Superintendent of Public Works,* Hon. EDWARD A. BOND, *State Engineer and Surveyor, of Water Storage Commission:*

GENTLEMEN.—As suggested in your letter of July 17th to Mr. Gideon Snell, Theresa, N. Y., we have secured such data as we could regarding Indian river above High Falls at Theresa, we have been unable to make this as complete as we would like to on account of lack of time to secure more definite information, however, we beg leave to submit the following:

First. As to Power Plants.—At Theresa the approximate value of water power plants is $80,000. At Philadelphia there are now water power plants using about 250 horse power, 600 more horse power could easily be developed. At Antwerp and above there for a distance of twelve miles by road there could be developed from three to six thousand horse power.

Second. Villages Depending on Indian River for Water Supply.—The villages of Theresa and Antwerp are entirely dependent on this supply for fire protection, both as to water used for this purpose and power to propel the same, they also get their water for domestic purposes from the same source; there are times during dry seasons when the supply becomes low, and at such periods the quality of water is poor and dangerous to health.

Third. Floods.—This stream is one in which the water rises rapidly at times. For the greater part of the distance traversed by this river the banks are low and much of the land near the river is low and flat and is overflowed in spring and fall and occasionally during the summer after heavy rains, the damage being greatest during the summer when the stream overflows its banks, many valuable crops being destroyed and other damage being done at such times. Bridges have frequently been carried

away and within the last two years near Philadelphia a young man was drowned while driving on the highway near the bank of the stream, horse and buggy being carried away by the water which at the time overflowed the highway.

Fourth. Location for Dams or Reservoirs.—After looking over the ground as carefully as the time at our disposal permitted, we are of the opinion that the proper place to make a large reservoir is at the outlet of Lake Bonaparte; at this point there is at present a dam which might be raised three or four feet with very little expense; the lake and land above this dam which is overflowed, at present covers about 1,600 acres; by raising the dam four feet we believe the storage capacity of the lake would be nearly doubled, as there are many swamps and bays in which the water would set back; this land is at present of small value and the right to overflow it could be secured without great expense. A reservoir at this location would hold the water from a large section of country and be of great value to prevent floods on Indian river.

Another point where a small storage reservoir might be easily made is at Sterlingbush, about eight miles below the outlet of Lake Bonaparte; at this point there is a pond four miles long and by renewing the dam, which was formerly used there to furnish power to a saw-mill and iron furnace, a good storage might be made.

At Theresa, a dam could be built above the present dam of Snell & Makepeace, or their dam could be raised fifteen feet; this would create a large reservoir.

We trust that this information will enable you to further your work in connection with Indian river. We will be pleased to furnish any further information at any time.

Yours respectfully,

(Signed.) GIDEON SNELL,
W. S. AUGSBURY,
C. O. ROBERTS,
Committee.

THERESA, N. Y., *September* 22, 1902.

Hon. E. A. BOND:

DEAR SIR.—Will you and Mr. Boyd kindly present the enclosed report to the full commission, and, if consistent with your views, try to get a favorable report from it. We think that with a recommend from your commission, the Legislature would give us the meagre relief asked for. Mr. Boyd expressed a friendly feeling toward the matter to me at Philadelphia, and I know you feel in the same way.

Truly yours,

L. W. TYLER.

To the Honorable Commissioners to Investigate Floods:

GENTLEMEN.—We the undersigned, committe to investigate the effect of floods on agricultural lands in this section, respectfully report that between the villages of Theresa, in Jefferson county, and Rossie, in St. Lawrence county, there are between three and four thousand acres of agricultural lands which in late years are liable to summer overflows of Indian river, greatly damaging and frequently entirely destroying the crops, last and the present season being examples, the crops having been almost entirely destroyed both seasons. There are obstructions or bars in said river that retard the free flow of water, which, if removed, would very much lessen the liability of the river to overflow its banks. We estimate that six thousand dollars judiciously expended would make a channel through the bars and add much more to the wealth of the State than the cost of the work. In former years, when the lands mentioned were cleared and brough under cultivation, summer floods were almost unknown. Many of the land owners are unable to bear their share of the expense of doing the work by taxation, even if that plan could be legally adopted, which at least is very doubtful, so it appears to us that if the work is done and the lands protected from floods, it must be done by the State.

We also respectfully report that Red and Muscallonge lakes, situate in the town of Theresa, are navigable from Indian river

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between the villages mentioned and are becoming quite a fishing and summer resort, on their banks being a number of summer hotels and cottages, and several steam and naphtha boats plying the river and lakes when water is reasonably high. The bars mentioned render the river unnavigable in low water, greatly to the inconvenience and damage of the public.

All of which is respectfully submitted.

GEORGE E. YOST,
S. E. CALSEY,
L. W. TYLER,
Committee.

THERESA, *September* 22, 1902.

Raquette River.

This river is the outlet of numerous lakes and ponds in the northern portion of Hamilton county; it flows northerly through St. Lawrence county, entering the St. Lawrence river near the Canadian line.

The upper portion of the watershed of the Raquette is a flat plateau whose lakes furnish good opportunities for storage at reasonable cost. After leaving this plateau the stream falls rapidly, forming many possible sites for water power development, a detailed list of which is given in the annexed report of the Pottsdam committee.

Drainage Area of Raquette River.

	Square miles.
Above Piercefield	695
Above Hannawa Falls	967
Above Massena Springs	1,188
Above mouth	1,240

The water surface areas of some of the lakes on the upper plateau tributary to the Raquette river are as follows:

	Surface area, square miles.
Blue Mountain lake	2
Raquette lake	10
Forked lake	2.3
Long lake	8.7
Little Tupper lake	4
Big Tupper lake	7.5

Storage can be secured in Big Tupper, Little Tupper, Long and Raquette lakes at a reasonable cost, owing to their being bordered by cheap, flat land, a great portion of which is a part of the State Forest Preserve.

Storage reservoirs can be built at other points on the Raquette, notably at Moosehead in Township 6 on Cold river, and on Moose creek.

To the Water Storage Commission of the State of New York:

GENTLEMEN.—On behalf of those of your constituents who reside near, or are connected with business having relations to the Raquette river—the undersigned respectfully represent:

That in common with all people located in sections bordering upon the Adirondack region, or who are engaged in affairs touching that portion of our State, we have great interest in the work of your Commission, and in the development of your investigations under Chap. 406, Laws of 1902.

We beg to submit, preliminary, that the constituting of a State "Water Storage Commission" by and by virtue of said act, indicates a legislative intent to provide for storage of overflow waters along our streams.

We assume that the enactment is a legislative declaration of the fact that floods and overflows are naturally injurious to the public, and that the checking of floods, the holding back—the storage of overflow waters, is naturally beneficial to the public.

We submit, that prevention of overflow and of floods, and storage of waters to prevent floods, are counterparts of the plan presented by the enactment.

We beg to further submit, that the fact that the storage of waters, which by reason of such storage may be made useful to the public in water power, is not an objection to such storage or use, but indicates that this public benefit to be derived from such storage was contemplated by the legislature in creating the statute.

Tree setting under a statute could not be reasonably objected to because of the selection of fruit-bearing trees and such as would become valuable timber. A freight canal is not less, but more, a public benefit when its surplus and overflow waters may be employed to aid industries. It cannot fairly be said that the purpose of an irrigation law is misdirected because a resulting waterfall will turn wheels of industry and manufacture.

Adirondack Streams.

The importance of the Adirondack waters to Northern New York and to the State can scarcely be over estimated.

Many towns and cities get their water supply from Adirondack streams. The water from these streams varies greatly. At certain times of the year the water is excellent in quality; at other times it is turbid and muddy, while perhaps the worst water of the year is during the lowest stages of the river in summer. The uniform flow from reservoirs would largely obviate these difficulties.

The watershed of the forest preserve is nearly 5,000 miles in area. The rivers which flow from it are the Hudson, the Schroon, the Boquet, the New Boquet, the Ausable, the Salmon flowing into Lake Champlain, the Saranac, the Great Chazy river, the Little Chazy river, the Chateaugay, Trout river, Salmon river flowing into the St. Lawrence, the Little Salmon river, the east branch of the St. Regis river, the west branch of the St. Regis river, the Raquette river, the Grass river, the Oswegatchie river, the Beaver river, the Moose river, the Black

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river, West Canada creek, the Mohawk river, the East Canada creek, Fish creek, Middle Sprite, the Sacandaga, the Indian river. Besides these there are a number of smaller tributaries and creeks, all of which would be benefited to a greater or less extent in years to come by reservoirs at their headwaters.

The highest engineering authority has determined by surveys, weather records and calculations that many of the Adirondack streams can be given an equalized flow of 2½ feet per second per square mile of drainage area. Many of these streams fall from near the source to the mouth from 1,000 to 1,500 feet. Assuming that but an average of 500 feet could be used for the whole watershed, and that the equalized flow amounted to but one cubic foot per second per square mile, a power could be realized of not less than 250,000 horse-power, operating 24 hours a day, and instead of being confined to a limited area where its use would be difficult or impracticable, this power would be distributed over a large part of the State, and would build up a manufacturing population which we now have not, and would vastly increase the taxable property of the entire State north of the Mohawk river. This power would bring it the blessings of pure and wholesome water, which alone would be worth the cost of the reservoir systems necessary to equalize the flow of the streams. Assuming that only the above-mentioned amount of power could be developed, it would take the place upon the basis of modern compound condensing engines of 500 tons of coal an hour, or 12,000 tons of coal a day, or of over 4,000,000 tons a year, and all such saving would take place where the cost of coal is high, averaging in ordinary time not less than $3 per ton.

For years it has been the complaint of Northern New York that, although heavily taxed for the Erie canal and its feeders, yet the benefits received were small, and it has been believed by many well-informed people that Northern New York has been injured by the canals, inasmuch as western farm products have been more directly brought into competition with our products and at our expense. In any view, it seems just that

the people of a part of the State which has but a share of the prosperity and population to which it is entitled should receive such proper care and attention as the State is able to give it, consistent with the best interests of the latter.

Reservoirs should be constructed under the control of the State for several reasons. They should be located and the height and character of dams determined by the best engineering skill, which might not be obtainable by private individuals or small municipalities. The construction of dams and embankments should be of the best, so that floods would be avoided, and they should be maintained carefully for the same reason.

The State, at great expense, has begun the purchase of lands within the borders of the Forest Preserve to protect the sources of our principal rivers. Should reservoirs be built, the work so well begun will be completed, and the flow of our mountain streams will be equalized. Floods at one time of the year and the low water at other times will be replaced by a uniform flow, which will result in preventing floods and overflows, and will accomplish the water storage contemplated by chapter 406, Laws of 1902, and will also result in the expenditure of large sums of money in the development of water-powers now valueless, in the employment of labor where none is now employed, in the supply of pure and wholesome water at all seasons of the year to a large territory in the State, and in a great increase of taxable property.

We submit that this matter is of great importance in connection with the continued purchasing of lands in the Forest Preserve by the State. The two measures should go hand in hand.

The construction of reservoirs by the State has been carried on for many years in Massachusetts, New Hampshire and Maine, and it is believed with the greatest benefit to all interests and to the State in general.

The Raquette River

is over 200 miles long; it is mostly in the forest, touches no canal, is not practically navigable for freight, but is a power stream. From the south line of Piercefield to near the northerly line of Norfolk this river abounds in waterfalls, capable of furnishing an immense aggregate of power.

Its capacities and value have been recognized in many statutes.

About 600 square miles of the watershed of the Raquette, composed very largely of lakes and ponds, is located at an altitude of about 1,750 feet above the sea. Besides the lakes there are many thousand of acres of swamps in which water collects, and from which it flows gradually.

The rainfall on this plateau, according to the records and investigations of Farrand N. Benedict, C. E., acting under the direction of the State Engineer, averages 65 inches per year, about twice the rainfall in this State at lower levels.

The opportunities for the construction of reservoirs about the headwaters of the Raquette are excellent. At the outlet of Tupper lake a dam 13 feet high will impound water having a surface of 32 square miles and of 6,000,000,000 cubic feet capacity. A dam 20 feet high will hold, if built across the outlet of Long lake, over 5,750,000,000 feet. A dam 10 feet high will store in Raquette lake 2,750,000,000 cubic feet. At Blue Mountain lake over 1,000,000,000 cubic feet. Beach's or Brandreth lake, 250,000,000 cubic feet. And there are over 50 other locations for dams which would impound from 200,000,000 to 3,000,000,000 cubic feet. At the cost of less than $50,000 for dams, at least 20,000,000,000 cubic feet of water can be reservoired at the sources of this river.

We beg to ask the attention of the Commission to the importance for impounding purposes to Little Tupper Lake valley in Hamilton county, comprising Little Tupper lake, Round pond and connected waters, which drain into Raquette river through Little Tupper lake stream, Bog river and Big Tupper.

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This valley presents large waters, together with considerable areas of low land, well situated for creating at small expense an extensive reservoir, where the overflow of the region can be readily held back to protect downstream localities.

Another important storage valley is that holding the Moosehead Stillwater, in Township 6, St. Lawrence county. A dam to be located in Township 5, or near its east boundary, can be conveniently so placed and constructed as to gather and hold upon said stillwater and contiguous lowlands a large body of water, thus checking floods.

Other reservoirs are entirely practicable, and may be readily established on Cold river and on Moose creek, both of which tributaries to the Raquette have been ascertained to possess valuable capacities for water storage.

One reservoir, located a short distance below the outlet of Tupper lake, was built on the Raquette some time since, and its re-establishment is under consideration. With this one reservoir the low-water flow of the river can be increased by the amount of 1,000 feet per second for 70 days.

Raquette River Water Powers Fully or Partly Developed.

Number.	OWNERS AND LOCATION.	Present head in feet.	If fully developed, head in feet.
1	Kent's Mills, in Norfolk	5	5
2	Raymondville (State Dam)	5	5
3	Raymondville Paper Company	14	14
4	Remington-Martin Company, Norfolk	44	44
5	Remington-Martin Company, Yaleville	12	20
6	Frost Paper Company, Norwood	10	20
7	Racquette River Paper Company, Union Mills	18	22
8	Racquette River Paper Company, Dewittville, (at 94.896 cubic feet per minute)	16	22
9	A. Sherman Lumber Company, Sissonville	12	14
10	Potsdam Village Power, Potsdam	8	10
11	Hannawa Falls Water Power Company	90	90
12	Racquette River Pulp Company, Colton	28	28
13	Piercefield Paper Company, Piercefield	34	34
		296	328

The nominal flowage of the stream is 94.896 cubic feet per minute.

The Following Water Powers of the Raquette Remain Undeveloped:

Name.	No. of feet in the fall.
Sols island	22
Starks Falls	40
Leonard Falls	75
Gain-Twist Falls	75
Rainbow Falls	70
Five Falls	70
South Colton Falls (yet undeveloped)	40
Higley Falls	25
Colton Falls (yet undeveloped)	250
Norfolk (yet undeveloped)	30
Comprising	697

In addition to the above powers now in use, and those specified as undeveloped water powers on this river, are the following well-known falls, viz.:

Buttermilk Falls, above Long lake; Raquette Falls, below said lake; Jamestown Falls, Moody Falls, each having over 70 feet fall in a mile. And also numerous small falls and rapids, capable of furnishing valuable water power.

While it is not practicable to estimate the money value of these several plants and water powers, presented to your attention, it is clear that the present employment in profitable manufactures of different lines as now existing is proof of large capacity for valuable uses.

Beyond this present application it may be permissible to repeat the recognized fact that water power has come to be regarded as the essential agent in the production of electricity, and that the latter force is becoming the economical and convenient instrument in all manufactures.

The value of the electricity that may be generated in employing even the unused water powers before specified is literally incalculable.

DAMAGES.

Injuries by Floods and Overflows of the Waters of Raquette River.

The undersigned further represent that from the head of the stream until South Colton is reached, the river flows through a forest country where the timber has been thinned out, and the snow melts earlier than formerly, and the volume of the stream after rains or thaws increases more quickly. High waters from fully cleared lands and also those from the forest now come at nearly the same time, and in increased volume.

At Raquette river, in Massena, some trouble has been occasioned by high water.

At Massena Springs also there has been bridge disturbance, and the park of the Spa was overflowed, and the bath building and the spring house were carried away by overflow from the river in a spring freshet.

At Kent's mill a wooden structure (bridge and piers) was carried away.

At Raymondville repeated and serious damages from overflow have been suffered. Overflows at this point are shown to have occurred nearly 30 years ago, and from time to time since. Near this village the Raquette is joined by a long tributary, and the two seem to contribute to the injuries complained of. Spring freshets have forced overflows along the principal street for three-fourths of a mile, flooding cellars and first floor rooms of stores, hotel and residences.

From thirteen to fifteen years ago the overflows were quite heavy. In 1900 the stream swept the street for a period, and stranded river ice left there had to be chopped away on subsidence. Overflows have occurred here in different years, and in January, in February and in March, respectively. One year a gristmill, woollen mill and a butter factory were swept away. Another year a nearly new iron bridge was swept out. In 1902 the overflow ran down the street from two to three feet in depth for one-third of a mile in a strong current, flooding resi-

dences and other buildings, forcing temporarily a new mail route, and causing considerable damage.

The State has recognized the public nature of the overflows which have taken place at Raymondville by making appropriations to prevent repetitions thereof. (See chap. 158, Laws of 1896; chap. 596, Laws of 1899, p. 1196.)

Norfolk village also has suffered severely from Raquette overflows. Some seven or eight years ago a large flood left the river and ran down the main street. In one place it excavated twelve feet in depth, to bed rock. The post-office building and other structures were swept away. Injuries have occurred here at other times.

In the winter of 1902 a current four rods wide, and about five feet in depth, struck out from the river across the same street, and ran one-third of a mile or more upon it. Sidewalks were torn out, water filled the cellars; it also flooded ground rooms to the height of three or four feet. People fled, and families were removed for safety.

At Potsdam some damage has occurred to property owners from overflows. Occupants of stores along the west side of Market street have suffered considerable annoyance and trouble from water coming from the river in times of spring high water. Residents upon Water street have been harmed in a similar manner, and have found their highway and sidewalks covered by spring freshets.

In the thaw of 1902 (herein elsewhere referred to) — and caused by the sudden melting of great stretches of snow fields both in and outside of the forests, because of the warm winds and rains while the ground remained frozen — much anxiety came from the quick rising of the stream, but a cold wave for a day checked the threatened flood at danger point, and but little actual damage occurred. At the time here mentioned the river overflow came upon the working floor of the Hewittville mill. A heavy train was kept standing on the Potsdam railroad bridge to protect it. It was estimated that five hours more of

continued rise then would inevitably have produced great public injury by the floods.

It has repeatedly occurred that damages worthy of being noted have come to lumbermen, and farmers, and land owners, by the reason of logs and debris being by floods thrown and left upon lands of riparian owners. Considerable damage, as well as the expense of removal, has come from this cause. A dozen points along the stream where such injuries from stranding have repeatedly occurred from overflows can readily be pointed out.

Damages from overflows in the Raquette have also occurred along the river at Allen's Island, and also in Pierrepont, and also at the village of Colton, and at other places.

It is respectfully submitted to the experienced judgment of the commission, that the removal of timber growth from the watersheds of rivers must naturally increase the volume and force of the stream in high water. The formation of the Adirondack region — of scarcely hidden unstratified rock, thinly covered by the light material of forest origin, tends to accelerate the gathering and rapid movement of the waters. Hence, it must be expected that increased danger of damages from floods and overflows will arise upon Adirondack streams.

VILLAGES.

The importance of this river to communities established along its course is obvious. The villages affected are mostly along the fifty miles of stream from "Racket River Bridge" to South Colton, inclusive.

South Colton is located on both sides of the Raquette, and has excellent water power. It is upon the natural line of early railroad development, and gives promise of becoming a manufacturing village at an early day.

The village of Colton, about five miles down stream, possesses the most notable waterfall existing upon this highly favored mill stream. The extension of a railroad to this point is being provided for. The development of water power, which will

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occur immediately, will necessarily result in a large village in the near future, when the river will undoubtedly be used for domestic purposes and for general water service, and for fire protection.

At Hannawa Falls, about four miles north of Colton, the water power has been greatly developed. A stone dam about thirty feet in height has been erected, beyond which a canal connects with a forebay having a fall of ninety feet. The development here will furnish from 12,000 to 18,000 horse power, according to the stage of the water. A large manufacture of mechanical pulp is already in operation, and the generation of electricity has been begun. This hamlet of Hannawa Falls must soon become a thriving village.

Potsdam village possesses a resident population of about 4,500 inhabitants, besides a large number additional during the school months, by reason of the considerable numbers of students who become temporary residents while attending the State Normal School and the Clarkson Memorial School of Technology, both large and thriving schools.

This village owns a large water power, which is used in part to deliver from the river the water supply of the village and its inhabitants. The whole water supply for domestic and potable uses, and for general purposes, and for fire protection (except where water from wells is still employed) is taken directly from the river, and is delivered where required by means of water works constructed by the village, and operated by an application of the water power above mentioned.

The use of the village machinery has several times been interfered with by high water, and the quality of the water received has sometimes been greatly deteriorated by reason of floods coming in periods of high water. Very low water is also unsatisfactory. A steady supply of water from reservoirs is needed to maintain the efficiency of the service, and to keep good the quality of the water.

Potsdam village is lighted by electricity generated at Hannawa by the use of the water power on the Raquette river.

The village of Sissonville, located about one and one-half miles below Potsdam, has a population of about 250. This is the site of the plant of the well known "A. Sherman Lumber Co." The power used is from the Raquette, and the whole of the stream is in use here in the manufactures of this company. Water power is also used for fire protection. The power employed is from 1,400 to 2,100 horse power, according to the stage of the water. The mills have railroad facilities.

Hewittville is about one ane one-half miles below Sissonville, and about three-fourths of a mile above Union Mills. The water powers at these two points are owned by The Racquette River Paper Co., and are employed indepedently in the manufacture of mechanical and sulphite pulp, and in converting the same into paper. The mills at both dams are now in process of enlargement, and on completion will class with the larger mills engaged in the business. The mills use the whole river at each dam, the present head being sixteen feet at Hewittville and eighteen feet at Union Mills, furnishing in the aggregate from 5,800 to 8,700 horse power, according to stage of water. Water supply is furnished and electric lights are driven at each place by the river.

Norwood village has a population of over 1,800, and has growing industries. It is now establishing a water service for the public. The water for domestic and potable uses, and for general purposes, and for fire protection, will be taken from the Raquette, and will be delivered through pipes by using a power of the stream. An electric lighting plant is now being installed for village and public uses, the generating power depending wholly upon said stream.

The L. L. Frost Company has recently established mills at this village for the manufacture of paper. The works are now in successful operation, turning out mechanical pulp as required, and manufacturing paper. The water employed amounts to from 1,400 to 2,100 horse power, according to stage. The power here is capable of a large increase.

Yaleville, one and one-half miles below Norwood, possesses a fall of twelve feet, furnishing from 1,700 horse power upwards,

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according to water stage, and this power is capable of sixty-five per cent increase. The Yaleville power, which is owned by the Remington-Martin Company, is engaged to supply the Norwood Electric Light Plant.

At Norfolk village are the Remington-Martin Paper Company's mills, which are driven by the Raquette. A large output of paper is here manufactured from mechanical and chemical pulp made here, the pulp wood for which is brought from Canadian points. The stream here furnishes from 6,300 to 9,400 horse power, according to state of the flow. The works and related buildings and residences are furnished with water supply and electric lights by means of the Raquette.

Norfolk village is located upon the banks of the stream here, and is rapidly increasing in population. All general uses that are made by villages of the water of contiguous streams may be fairly expected here.

The Raymondville Paper Company, occupying a dam situated about three miles below Norfolk, has recently constructed a mill filled with new and excellent machinery, and is engaged in the manufacture of paper. The whole river is here used by the company. The present head is fourteen feet, comprising from 2,000 horse power at nominal flowage to 3,000 at high water.

PIERCEFIELD FALLS.

While soliciting the attention of the Honorable Water Storage Commission, to the villages and the water power improvements dependent upon the Raquette river, we beg the commission to give due consideration to the village of Piercefield, which has railroad facilities, and employs Raquette power at a notable fall, located in forest country southerly from Potsdam about fifty miles as the stream winds.

A large paper manufactory has come into existence here, supplied with all modern equipments and appointments, and has drawn about it a population of about 1,200. There is a head of thirty-four feet, resulting in from 4,800 to 7,200 horse power, according to the height of the water.

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The village receives its water supply from the river, and is electrically lighted by its use.

Several minor locations and villages along this stream are each considerably dependent upon this river, and are subject to injuries from it. All of these, together with all those above specified, will be benefited by improvements which shall tend to establish and maintain a more equable and uniform flow of the waters of the Raquette river.

The undersigned respectfully present the foregoing statements and suggestions to the Water Storage Commission of the State — and urge that the waters of the Raquette river are shown, beyond question, to be subject to serious floods and overflows which result in public injury; and that it is also shown that storage reservoirs are practically along said stream to prevent such floods and overflows.

It is also submitted that such reservoirs will prove of much practical utility, and will benefit the industries, and enhance the value of the property of the state.

A. X. PARKER,
E. A. FLANAGAN,
O. H. TAPPAN,
Committee.

Attest

GEO. W. SISSON,
Chairman.

September 25, 1902.

ST. REGIS RIVER.

This stream rises in various Adirondack lakes in the southern part of Franklin county, flows northerly into and through St. Lawrence county and enters the St. Lawrence river at St. Regis village. Like most of the streams flowing north from the Adirondacks, its water-shed consists of a high plateau, then a steep rocky portion, followed by a low plateau near its mouth.

The water-shed areas of the St. Regis river and its principal branches are as foHows:

	Square miles.
West branch of St. Regis	280
East branch of St. Regis	347
St. Regis, below junction	627
Deer river	212
St. Regis, at mouth	910

Water powers have been developed at Parishville, West Stockholm, Skinnerville, Brashers Falls, Brasher Center and Hogansburg. There are undeveloped power sites at Sylvan Falls, High Falls, Kerr Falls, Whittaker Falls and Allens Falls.

Additional storage can be secured by raising the dams on several of the larger lakes at the headwaters of the East and West branches of the river. Considerable damage is caused to property along the St. Regis river by spring floods — as is shown in detail in the annexed report of the committee of citizens of St. Lawrence county.

To the Honorable, the Water Storage Commission of the State of New York:

The undersigned, for themselves, and for others similarly situated, being of those interested in property located upon and business carried on along settled portions of the St. Regis river, in the county of St. Lawrence, beg leave to report:

That the St. Regis river rises in Franklin county, and is in the main a forest stream until it reaches St. Lawrence county.

It is comprised of the East branch and the West branch, which unite in Stockholm, near the Ogdensburg and Lake Champlain line of the Rutland Railroad. The East branch comes from the St. Regis lakes, and passes through Santa Clara, St. Regis falls, Nicholville and Fort Jackson.

Deer river flows through Dickinson, Lawrence and Brasher, and is received by the St. Regis river at the village of Helena.

The West branch heads northerly of the head of Upper Saranac lake, and receives the waters of St. Regis, MacDonald and Bay ponds, and those of many others located in the secluded region through which this stream runs. This branch is broken by falls capable of furnishing valuable water power. It also

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has several "levels," notably, the Ten Mile, the Five Mile and the Three Mile stillwaters, which lie between Bay pond outlet and the village of Parishville. Each of these stillwater levels is capable of being converted into an extensive reservoir.

Coming downstream, Parishville is the first manufacturing village on this river, and possesses excellent water powers. It is in convenient reach of the railroad above named, and also of the New York Central Railroad. Population, 800 to 1,000. The water falls at this village 125 feet or more. The mills here include a gristmill, machine shop, sawmills, planing mills, an electric light plant, and an extensive factory for the manufacture of butter tubs. The annual output includes from three to four million shingles, 600,000 spruce butter tubs, and from eight to ten million feet of lumber. The village is lighted by electricity furnished by private parties, and generated by the use of said water power.

WATERFALLS.

At Sylvan Falls, about seven miles upstream from Parishville, is a fall of about 120 feet in 100 rods. Three miles farther up is a cascade called High Falls, which offers an extensive power.

Many other prospective mill sites are found along the stream. Below Parishville is the Kerr Fall, a nearly natural dam, with about 18 feet fall. About two miles below Parishville is the Whittaker Fall of about 40 feet, and farther down is a picturesque resort, known as Allen's Falls, where the cascade is 60 feet or more.

At West Stockholm are two dams, about one-half a mile apart, with from 9 to 10 feet fall at each. At the first dam are large lumber mills, run by Gibson & Son, and at the second are a gristmill, a machine shop, a woollen mill and a woodwork mill, etc.

Farther on, at Skinnersville, is a dam, 8 feet fall, with sundry mills.

Brasher Falls is a thriving village about one mile below the junction of the East and West branches, and is nearly the same distance from the Rutland Railroad. It has about 1,000 popu-

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lation. The fall is about 55 feet in a half mile, with two dams some 25 rods apart. At this village are pump manufacturing works, machine shop, woollen mill, gristmill, shingle mill, starch factory, broom handle factory and other works.

Mill powers are also two miles below Brasher Falls; also at Brasher Center, and also at Hogansburgh, where there is a stone dam at the head of the dead channel, which extends to the village of St. Regis and the river St. Lawrence.

INJURIES FROM FLOODS AND OVERFLOWS.

It is recognized that during recent years the high water has come earlier in the season, and in larger volume, than formerly, and dangers therefrom are correspondingly increased. Along portions of the stream in Stockholm the banks are low, and as the river approaches the St. Lawrence the country is quite flat, and in all of this territory considerable injuries have been suffered by mill owners and villagers, riparian occupants and municipalities, from high water and overflows, which have flooded lands, left debris upon farms, piled ice in highways, destroyed bridges, torn out dams, carried off property, and swept away mills and machinery.

More than thirty years ago a bridge, gristmill, sawmill, and one-half of the dam at Hogansburg were swept away. A few years later a dam, sawmill and bridge were torn out at the same place. About 1870 ice was by high water piled twenty-five feet high in the highway, and a new road had to be provided.

At Helena at least two bridges have been carried out. Nearly all other bridges over the lower river have been raised from two to four feet.

The bridge known as the Landing Bridge, in Brasher, is reported to have been carried off several times. About 1860 the bridge and dam at Brasher Center were carried down, and a large number of mill logs were swept into the St. Lawrence and lost.

Some five years ago a shingle mill, feed grinding mill and a cheese box factory were destroyed by high water at the Wilkinson mill site.

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At Brasher Falls many river injuries have occurred. Bulkheads, flumes and sawmills have been carried out repeatedly. Some ten years ago a torn-out sawmill was rebuilt; two years later one-half was torn away. Heavy miscellaneous damages have been suffered here from floods and overflows many different years.

By chapter 645, Laws of 1901, an appropriation of $3,500 was made for the purpose of erecting a dam at Brasher Falls "for the protection of health and property, and the prevention of the forming of ice gorges, causing dangerous floods in said river in said vicinity."

This improvement is now nearly completed, and may protect the citizens against one class of damages to which it has been subjected. While it is hoped that this effort may be successful, there are several kinds of injuries and many localities upon the stream that this improvement cannot reach.

In 1901, in the vicinity of Parishville, bridges were taken off by the high water. In the winter of 1902 a freshet occurred which seriously threatened to destroy all of the river industries of that village. The stream then marked a higher point than it had ever been known to reach. The intervention of a cold wave which checked the thaw and held back the water coming from the wilderness, suddenly relieved the peril referred to.

RESERVOIR SITES.

It will be noted that the most serious injuries occasioned by the floods of the St. Regis have occurred down stream from the junction of the east and west branches.

It is understood that there are several "levels" upon the east branch that may at reasonable cost be converted into reservoirs, to hold back the incoming waters, so as to prevent further injuries.

The west branch offers an excellent opportunity to establish an extensive storage reservoir throughout the Ten Mile level, by the erection of a dam at the foot thereof.

Still farther down stream, at the foot of the Five Mile stillwater, a dam may be readily built which will here hold a large

amount of water. This site was occupied by the State several years ago for the placing of a flowage dam then erected.

Still farther down, at the foot of the Three Mile stillwater, is an acceptable location for the establishment of a third storage reservoir.

Should still other storage be deemed advisable, the same may be secured by other dams, and by raising the levels of several ponds.

It is respectfully submitted, that the St. Regis river, and the dwellers along its shores are shown to be entitled to the consideration of this Honorable Commission in the important and valuable investigations being made under chapter 406, Laws of 1902.

B. A. BABCOCK,
Brasher Falls, N. Y.
ROYAL NEWTON,
Parishville, N. Y.
S. L. CLARK & SON,
Parishville, N. Y.

Attest,
GEO. W. SISSON, Potsdam, N. Y.

GRASSE RIVER.

This stream drains a long, narrow territory lying between the water-sheds of the Oswegatchie and Raquette rivers in St. Lawrence county, and empties into the St. Lawrence river about five miles west of Hogansburg.

The watershed of the Grasse is of the same general character as those of the Raquette and Oswegatchie, except that it has fewer lakes or available sites for storage.

There are 14 existing dams on the Grasse river and its branches, where the power is used in grist mills, saw mills and pulp or paper manufacture. At Massena 35,000 horse power is developed by taking water from the St. Lawrence in a canal three and one-half miles long and using the Grasse river as an outlet for the tail race.

SARANAC RIVER.

The Saranac river has its source in a cluster of lakes in the southern part of Franklin county, the principal ones being the Upper and Lower Saranac lakes. It flows northeasterly through portions of Franklin, Essex and Clinton counties, entering Lake Champlain at Plattsburg.

The water-shed of the Saranac river has an area of 628 square miles, about one-half thereof being wooded. The lakes on the headwaters of this river have a water surface of 21 square miles, affording considerable water storage. This storage can be largely increased at a comparatively small cost for construction, but the land damages on the Saranac lakes will be considerable owing to the large private residences and summer hotels on their banks.

The area of merchantable timber likely to be cut on the watershed of the Saranac river is small, owing to the large area owned by the State or by private parties as a forest preserve.

There are few developed powers on the Saranac river, the largest being at Saranac Lake village, Cadyville and Plattsburg. There is an undeveloped power at Franklin Falls with a possible fall of 60 feet. A storage reservoir can be formed by a dam on the Saranac river where it crosses the line between Franklin and Clinton counties, near Union Falls.

AUSABLE RIVER.

The Ausable river drains several lakes in the northwestern part of Essex county; flows northeasterly into Clinton county and enters Lake Champlain at Ausable point, about 12 miles south of Plattsburg.

The watershed has an area of 519 square miles, mostly partly wooded, mountainous territory.

There are few small developed powers on the Ausable, as the merchantable timber has mostly been cut, and the old dams, being no longer used in floating logs, have been allowed to become dilapidated. There is an undeveloped water power site at Wilmington notch with a fall of 100 feet.

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The remaining streams tributary to the St. Lawrence river or Lake Champlain in Franklin and Clinton counties are the Salmon, the Big Chazy, the Chateaugay and the Trout. The areas of their watersheds are as follows:

	Square miles.
Salmon	480
Big Chazy	300
Chateaugay (in New York State)	200
Trout (in New York State)	129

These streams rise in the foothills of the Adirondacks and are not subject to the excessive floods of those streams that rise on the higher plateau. There are small water powers at various points on each of them, but there is no available data as to their number or size.

SALMON RIVER (Ontario).

This stream rises in the western part of Lewis county and flows west, entering Lake Ontario at Port Ontario.

The area of the watershed at its mouth is 285 square miles, and at High Falls 190 square miles.

There are five small water powers on this stream between High Falls and Lake Ontario and 110 feet vertical fall can be obtained at High Falls.

The deep waterway report describes a proposed reservoir above High Falls to store 7,500,000,000 cubic feet for feeding the proposed deep waterway.*

The estimated cost of the reservoir was $1,350,000.

A dam 35 feet high at the site of an old dam about one mile above High Falls would flood 4.48 square miles and store 1,995,000,000 cubic feet and serve for the regulation of the floods in the lower reaches of the river.

Respectfully submitted,

CHAS. S. BOYD.

EDWARD A. BOND.

*Report on Water Supply Investigations. Appendix 16, pp. 873-881.

PART III.

APPENDICES.

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APPENDIX No. 1.

Supplemental Matter from First Division.

Report of Rochester Flood Committee, with exhibits.

Report of Hornellsville Flood Committee, with photographs and map.

Report of Canisteo Flood Committee, with photographs and maps.

Report of Elmira City Engineer, with maps and flood profiles.

Report of Olean City Engineer, with photographs and map.

Report of Buffalo Flood Committee, with maps, profiles and diagrams.

Report of Oak Orchard Flood Committee, with maps.

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REPORT

OF THE

General Committee of the City of Rochester

APPOINTED TO CO-OPERATE WITH THE

STATE WATER STORAGE COMMISSION.

1902.

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Daniel B. Murphy,
M. J. O'Brien,
Joseph O'Connor,
Col. Nathan P. Pond,
Pierre Purcell,
L. P. Ross,
Hon. W. A. Sutherland,
Hon. John Van Voorhis,
Sole Wile.

Sub-Committee on Scope of the Rochester Committee.

Hon. A. J. Rodenbeck, *Chairman.*

Hon. William A. Sutherland,
Henry B. Hathaway,
Lewis P. Ross,
Daniel B. Murphy.

Sub-Committee on Statistics of the Rochester Committee.

E. A. Fisher, *Chairman.*

J. Y. McClintock,
E. Ocumpaugh,
Pierre Purcell,
J. J. Mandery,
H. S. Woodworth.

Auxiliary Committees.

Geneseo, N. Y.

R. L. Doty,
George Austin,
W. W. Willard.

Mt. Morris, N. Y.

John F. Connor,
John F. Donovan,
H. E. Brown.

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REPORT.

ROCHESTER, N. Y., *September* 29, 1902.

To the Water Storage Commission:

SIRS.—We beg leave to transmit herewith the material collected by the local committee of the city of Rochester on the subject of the overflows of the Genesee river and its tributaries.

In accordance with the suggestion of your commission, when in Rochester, that there be prepared a draft of a proposed bill for the construction of regulating reservoirs, such a message was prepared. It contemplates the construction of the reservoirs by a commission and the collection of the expense by assessment. The following is a draft of the bill:

AN ACT for the construction and maintenance of regulating reservoirs on the Genesee river and its tributaries, and to pay the cost and expenses thereof by assessment and making an appropriation therefor.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. The commission heretofore appointed, known as the Water Storage Commission, to investigate the causes of floods and overflows of rivers and water-courses, is hereby continued, and said commission shall report within sixty days from the passage of this act to the Appellate Division of the Fourth Department, as to the necessity for the construction of regulating reservoirs on the Genesee river and its tributaries, for the purpose of protecting life and property and preserving the public health.

§ 2. When the report of said commission shall have been confirmed by said court, there shall be no appeal therefrom, and thereupon said court shall appoint five commissioners to be known as the Genesee River Commission, at least one of whom shall be a citizen of Monroe county, one of Livingston county, and one of Wyoming county, and said court may fill any vacancies in said commission from time to time.

§ 3. Before entering upon the discharge of their duties, each member of said commission shall take the constitutional oath of office and file the same with the clerk of Monroe county, and said commission shall make rules to be approved by a justice of the said Appellate Division, for the orderly conduct of its duties under this act. It shall choose one of its number to be its treasurer, who shall give and file in said clerk's office a bond in such amount and terms as shall be approved by a justice of said Appellate Division.

§ 4. Said commission shall cause to be made surveys, maps, plans and specifications of the proposed reservoirs, the location of the same, the estimated cost and expense thereof, not exceeding two million dollars, the area to be benefited thereby, and the respective benefits received by the state and each county, city, town or village, lands, rights and interests benefited, and shall make a report thereof within one year from their appointment to said Appellate Division.

§ 5. The Appellate Division may confirm said report as presented, or it may modify or alter it, as it may deem necessary to promote the interests of justice and confirm it as so modified or altered, and from its order confirming said report there shall be no appeal.

§ 6. When said report shall have been confirmed, said commissioners shall be empowered to issue bonds or certificates of indebtedness, as such commissioners, running for a period not exceeding fifty years, at a rate of interest not exceeding 4 per cent. per annum, the proceeds of which shall be used for the construction and maintenance of any regulating reservoirs constructed under this act, and for the payment of any interest or other expenses connected therewith. Said bonds shall be sold to the highest bidder after due notice to be published for ten days in such newspapers as said commission may select and upon sealed proposals at not less than par.

§ 7. Said commission shall have power to construct said reservoirs and appurtenances according to the surveys, maps, plans and specifications so approved. Bids for the construction of the same shall be advertised for one week in a newspaper published

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at the county seat of each county in which any lands are to be assessed, and the award of any such contract shall be made to the lowest responsible bidder at not exceeding the estimate therefor, which estimate may be amended, and any and all bids may be rejected. Each bid shall be accompanied by a bond conditioned for the faithful performance of the contract, and with such other terms as said commission may determine.

§ 8. Said commission shall determine the amount to be paid by the state, and by any county, city, town or village in the assessable area, and such amounts shall be a charge respectively upon the state, and any such county, city, town and village enforceable by said commission as now provided by law for other charges. Said commission shall annually certify to the city, town and village assessors the amount to be spread upon any lands, rights or interests benefited within their jurisdiction, and said assessors shall have power, and it shall be their duty upon receiving notice of such amounts to be assessed, to spread and assess the same upon the lands, rights and interests according to the benefits accruing, and the assessments when duly attested by the oaths of the assessors shall be a lien to the same extent, and shall be collected and enforced in the same manner as the general taxes of such city, town or village, and when collected shall be turned over to said commission.

§ 9. Said commission shall pay the interest on any bonds, or certificates of indebtedness, issued by it and shall provide for the payment of such bonds, or certificates of indebtedness, so that the first series of fifty thousand dollars shall be payable ten years after the date of issue and an equal amount shall be retired each succeeding year.

§ 10. Any political division or person who may be assessed, or liable to be assessed, under the provisions of this act, may be heard before said Appellate Division on the confirmation of any report made pursuant to this act, and said Appellate Division may confirm any report in whole or in part, send it back for correction or refer any question connected therewith. Said Appellate Division or a justice thereof may extend the time for making the reports of said commission.

§ 11. The sum of twenty-five thousand dollars, or so much thereof as may be necessary, is hereby appropriated from any moneys in the treasury not otherwise appropriated, for the purposes of this act, which sum, or so much thereof as shall have been expended shall be assessed as herein above provided upon the political divisions, lands, rights and interests benefited, according to benefits received, and when collected shall be turned over to the state treasurer.

§ 12. This act shall take effect immediately.

This bill was submitted to the committees appointed at Mt. Morris and Geneseo but did not meet with their approval because it embraced the entire subject in one bill. It was suggested by the committee, at Mt. Morris, that the bill be divided and that it first be determined what the assessments would be before the interested parties be committed to the construction of the reservoirs. Carrying out this suggestion a bill has been prepared amending the act under which your commission was appointed so as to provide that your commission should ascertain the necessity for the construction of regulating reservoirs on the Genesee river and its tributaries, determine the cost of such reservoirs and the assessments to be levied therefor.

The following is a copy of the foregoing bill:

AN ACT to amend chapter four hundred and six of the laws of nineteen hundred and two entitled, "An act to provide for the appointment of a commission to investigate the causes of floods and overflows of rivers and water-courses, and to make recommendations for preventing the same, and making an appropriation therefor," relating to the Genesee river and its tributaries.

The People of the State of New York, represented in Senate and Assembly, no enact as follows:

SECTION 1. Section four of chapter 406 of the laws of nineteen hundred and two is hereby amended so as to read as follows:

§ 4. Said commission shall ascertain the necessity for the construction of regulating reservoirs on the Genesee river and its tributaries, for the purpose of protecting life and property and

preserving the public health from floods and overflows of said river and its tributaries, the cost and expenses of such reservoirs and appurtenances, the respective benefits received by the state and each county, city, town and village, lands, rights and interests benefited, and report thereon to the next session of the legislature.

§ 2. Section five of this act is hereby amended so as to read as follows:

§ 5. The sum of ten thousand dollars, or so much thereof as may be necessary, is hereby appropriated from any moneys in the treasury, not otherwise appropriated, for the purposes of such commission. Said sum, or the amount expended, except the portion which the state should equitably bear, to be refunded to the state out of the proceeds of any bonds or certificates of indebtedness issued for the construction of said reservoirs.

§ 3. This act shall take effect immediately.

HENRY C. BREWSTER,
Chairman of Rochester Committee.

The sub-committee on *Scope* presented two reports which are as follows, viz:

First. Report of the Sub-Committee on Scope to the General Committee Appointed to Co-operate with the State Water Storage Commission.

By chapter 406 of the laws of 1902, the governor was authorized to appoint a commission to make such surveys and investigations as may be proper, to determine the causes of the overflows of the various rivers and water-courses of the state, and to determine what can be done, if anything, to prevent such overflows.

In order to aid the commission in its labors, and for the purpose of presenting to it the facts relating to the overflow of the Genesee river, the general committee was oppointed, and this sub-committee has been designated to consider and present the scope of the inquiries for the examination of your committee. It seems to this sub-committee that the extent of the overflows of the Genesee river, not only in Rochester, but south of the city, are proper subjects of inquiry. The high water of the last few days unprecedented for the season, did little damage in Rochester,

but was disastrous up the valley, and emphasizes the necessity for measures to prevent overflows, which not only affect Rochester, but the territory through which the river runs. While Rochester escaped damage in the July high water and also escaped great injury from the freshet of last spring, yet the margin of safety was absolutely nothing. For several days in the spring of 1902 the surface of the flooded river was six feet higher than the summer level of water in the canal in the heart of the city, and this was within a mile of the center of the city with nothing to prevent that vast flow from rushing through the main streets and doing damage to the extent of millions of dollars, except a dam of ice that no one living could tell would endure for another hour. Not only was this a menace to Rochester, but a portion of the flood threatened to go east in the canal at such an elevation as to overflow its banks and rip out the great embankment across the Irondequoit valley, with the result of injuring the lives of hundreds of people and vast amounts of property. This menace was little reduced by the unusual procedure on the part of the canal officials of making literally a stone-filled dam by the use of hundreds of yards of paving brick which happened to be available.

But while Rochester escaped serious damage and possible loss of life during the spring flood and during the high water of July, 1902, the people up the valley were not so fortunate. The damage to crops during the month of July by floods over the flats between Dansville and Rochester has been fully $500,000. There are about 30,000 acres in these flats constituting as rich and productive an area as there is in this state. This land is all available for raising the most profitable crops provided the floods can be obviated. On account of the possibility of floods which happen irregularly and unexpectedly, the largest portion of this exceedingly rich land is only available for grazing, and even for this purpose is largely depreciated in value by reason of the risk of overflow. The indirect advantage to the district from making these lands available for raising fruits and vegetables instead of merely using them for pasture, would be many millions of dollars and would give employment and sustenance to a very much larger number of people, and furnish employment in the great canning factories and other industries that would be maintained.

Other great floods which have occurred in the Genesee river in the past, have done corresponding damage. Illustrating this, it might be said that one of the proprietors up the valley whose tenants suffered by the overflow of the flats, reduced their rental for that year by $18,000. The great flood of 1865 caused a damage in the city of Rochester alone of over a million of dollars. These facts show that the subject is one not alone of local concern and the inquiry of your committee should include the collection of data with reference to the overflows of the river, not only in the city of Rochester, but in the upper valley. The material with reference to Rochester can be gathered, so far as the earlier floods are concerned, from the exhaustive reports on the subject, and particularly those of Mr. George W. Rafter who, fortunately, is a member of the state commission, and with reference to the more recent floods by taking the testimony of interested parties before the sub-committee appointed to collect statistics. This committee might also visit the whole flooded territory, and obtain on the ground testimony of the parties affected necessary to show the full extent and damage occasioned by the overflow.

After the facts as to the extent of the overflows of the river have been secured, it will be pertinent to examine into the causes of such overflows. This inquiry should not be limited merely to local conditions such as the effect of the aqueduct and the absence of sufficient embankments but should extend to the results of the cutting off of forests and the clearing up of lands as likely to lead to heavier floods from year to year.

Having determined the extent of the overflows and examined into the causes therefor, the remedy naturally should be considered. In this connection your committee should not confine itself to partial and temporary remedies such as the construction of retaining walls or the building of tunnels which would afford to some extent local relief, but your committee should consider the great problem of the river's regulation by the construction of a storage reservoir and its effect upon the country through which the river passes, the rights and obligations of the citizens affected and the duty and opportunity of the state in the premises.

The protection of life and property is not one which devolves primarily upon the individual but is one which rests upon the

state. The great destruction of property which has been occasioned by the recent flood of the Genesee river, the loss of life and the damage to property which has been done in the past requires immediate attention and the application of the most speedy remedy at hand. It is not a matter for local treatment or for private enterprise. The construction of a tunnel and embankments at Rochester might to some extent relieve the city but they will not affect the lowlands near Mt. Morris and at other points along the river. Whatever remedy is proposed should be one sufficiently broad to afford relief to all who are affected by the overflows. The most obvious and only effective remedy and the one which has been discussed particularly during the past twelve years is the construction by the state of a storage reservoir at Portage or Mt. Morris, or at both places, which would enable the state to impound the water of the Genesee during flood periods and thus protect the life and property of its citizens along the course of the river.

The overflow of the beautiful region below Mt. Morris not only injures or destroys soil and crops and interferes with the best uses to which the land might be put but through stagnating pools of water left standing on the flat area endangers the health of local residents and deters others from locating there. The state's responsibility for damages thus occasioned is well recognized and is evidenced by the payment of damages to the citizens of Rochester by the state on account of the flood of 1865.

By the construction of such a dam or dams the state would be fulfilling not only its obligation to protect the lives and property of its citizens dwelling along the river but also would be discharging an obligation which it owes for interference with water rights. The state is now taking large quantities of water from the Genesee river for the operation of its canal. This is an interference with the uninterrupted flow of the river and an impairment of the water rights of property owners below the point where the water is abstracted. Enlargements of the canal are contemplated and there are in progress improvements which will require a still larger supply of water from the Genesee river. This additional supply can not be taken without interfering with valuable water rights. The recognition by the state of the unjust interference with these rights and the construction of a

reservoir to compensate property owners for damages would be nothing new, for the state has already acknowledged this principle by creating reservoirs from which the canal could by no possibility receive water for the express purpose of indemnifying mill owners for water diverted to the canal.

But aside from the obligation of protecting the life and property of its citizens and its liability for interference with water rights by the abstraction of water for canal purposes, the state should undertake the construction of a storage dam or dams from the broad standpoint of public policy. Fuel is becoming scarcer and scarcer. It is a well known proposition that the known supply of anthracite coal will be exhausted in fifty years and it is obvious that with the tremendous increase in the use of soft coal its cost is bound to increase in the near future. At the present time it costs at least $65.00 per horse power per year to create steam power. The proposed regulation of the flow of the Genesee river by a dam at Portage alone would create a permanent power of 60,000 horse power. To create this power by steam would cost $3,900,000 a year. The cost of creating and maintaining water power would probably not exceed $10.00 per horse power per year. This would make the annual cost of 60,000 horse power $600,000 which would show an advantage in favor of water power on this river alone of over $3,000,000 per year. This sum is three per cent of $100,000,000. The sum of $100,000,000, therefore, may be considered a fair measure of the possible value of the Genesee river as a power producer below Portage. This is a permanent value. It does not depend upon the deposits of oil, gas and coal, which in the course of years become exhausted. If the state could utilize the power which thus might be created, its revenues therefrom would be large. It might not be able to rent the power immediately but where there is power to rent, manufacturers will locate and it would not be long before manufacturing plants would build factories and gladly pay the rental to the state. This is illustrated by the movement of various great manufacturing enterprises from other parts of the country to Niagara Falls and the creation of absolutely new industries. This argument not only applies to the Genesee river, but to the other rivers of the state where the possibilities for generating

power are present. This phase of the question and its great value to the state should be urged to the end that the state may not commit the folly so often indulged in by municipalities in the past of surrendering valuable franchises without adequate returns to the public. The state should construct the dams not only so that it may discharge its obligations but so that it may accept the opportunities before it and the great benefits which such construction would afford.

It, therefore, seems to your sub-committee that the general committee should collect data as to the extent of the overflows of the Genesee river, examine into the causes therefor and suggest the construction of storage reservoirs as the only effectual and complete remedy and that this course should be urged because of the obligations of the state to protect the life, health and property of its people, its liability for water rights with which it has interfered and is likely still further to impair and because the construction of such storage dams ultimately will bring great benefits and large financial returns to the state.

ROCHESTER, N. Y., *July* 23, 1903.

A. J. RODENBECK,
WM. A. SUTHERLAND,
HENRY B. HATHAWAY,
LEWIS P. ROSS,
DANIEL P. MURPHY.

Second Report of the Sub-Committee on Scope to the General Committee Appointed to Co-operate with the State Water Storage Commission.

NEW PLAN OF RAISING MONEY FOR STORAGE DAM.

Mayor Rodenbeck Suggests that the Property Benefited be Assessed for Cost of Reservoir.

State, City and County and Property Owners Along River to be Taxed proportionately. — Plan to be Submitted to the State Flood Commission When it Meets Here To-Morrow.

Mayor Rodenbeck suggested a new plan for building a storage dam in the Genesee river at a meeting of the city flood committee held at the Chamber of Commerce late yesterday afternoon. The suggestion of the mayor was embodied in the report of the sub-committee on "scope," of which he is chairman, and contemplates assessing all benefited property for the cost of the dam or reservoir.

It is proposed that the state, city, county and property owners doing business along the river be assessed proportionately for the storage dam, a long term bond issue to carry out this plan being suggested.

"In the report which the sub-committee presented to the city committee, July 23, 1902, it was urged that the city committee should collect statistics as to the extent of the overflows of the Genesee river. This work has been done by the sub-committee on statistics, which will present its report at this session of the city committee.

"From the report of the sub-committee on statistics, the city committee will be enabled to draw its conclusions as to the causes of the frequent overflows of the river, but if a more exhaustive report on this phase of the question is desired, further

information might be secured by a committee especially appointed for that purpose.

"The sub-committee on scope in its report to the city committee suggested the construction of storage reservoirs as the only effectual and complete remedy which would fulfill the obligation of the state to protect the lives, health and property of its people, discharge its liability for interference with water rights which would be at the same time of great benefit to the state.

"The committee on scope did not undertake to outline any plan for the construction of such storage reservoir and in this supplemental report it desires to dwell upon this phase of the question and to refer to the three methods by which such storage dams might be constructed.

"It has been urged frequently that the construction of storage reservoirs for the purpose of regulating the flow of the river and developing its water power should be undertaken by private enterprise. This is insisted upon by some because the advantages will accrue largely to water right owners from the construction of such reservoirs.

"It must not be forgotten, however, that there are great interests besides water rights that will be benefited by the construction of such storage dams.

"There will be benefits to the state of New York resulting from the creation of a vast amount of property, in furnishing a water supply for the Erie canal, and enlargement thereof, in decreasing the danger of damage to the Erie canal from floods and damage to life and property through the Erie canal and by reducing the damage to property in the city of Rochester on account of deficient openings in the aqueduct carrying the Erie canal across the river; to the owners of the 50,000 acres of rich alluvial flats which will be protected from overflow and thereby largely increased in value.

"There will be benefits to the city of Rochester by improving the health of the city, by increasing the low water flow in warm weather, by reducing the danger of damage to property, health and life by floods; by making it possible to dispose of a portion

of the sewage of the city by emptying it into the river, by furnishing a source for an unlimited supply of water suitable for manufacturing purposes and for protection from fire and for the sprinkling of streets.

"There will be benefits to the county of Monroe by improving the health conditions, developing opportunities for new enterprises and by preventing the overflow of a large area of low cultivated lands; to the county of Livingston by improving the health of a large area, developing resources, exempting from overflow an immense acreage of tilled flats and decreasing the damage by floods to highways and bridges and the interruption of communication; to the Erie railroad, the Western New York & Pennsylvania railroad and the Lehigh Valley railroad by exemption from damage by floods.

"It is largely because of these diversified interests and benefits that private capital has not been invested to an extent which will afford relief to all concerned.

"On April 29, 1898, by chapter 605 of the laws of 1898, the Genesee River Company was incorporated to construct and use a dam or reservoir near Portageville for improving and preserving the public health, checking flood, furnishing water for enlarging the Erie canal and for municipal purposes and developing, utilizing and disposing of the waters and water power of the river and its tributaries above and below said dam or reservoir.

"This company was authorized to issue stock to the extent of $3,000,000 and to increase its capital stock to $12,000,000. The company, however, was required to expend at least 10 per cent. of its three millions of capital stock on the work of construction within five years from the day of the passage of the act and in default thereof it was provided that the corporation should be dissolved. Its time limit will expire April 28, 1903.

"It is not likely that the terms of the act will be complied with. One of the difficulties lies in the fact that the company has no authority to condemn or impose any portion of the burden of constructing the reservoir upon the existing water rights which will be so largely benefited by the construction of the dams. These water rights, particularly in the city of Rochester, are

almost entirely under the control of another private corporation. Until satisfactory arrangements can be made between these two companies or any private companies authorized by the state to construct storage reservoirs, it is difficult to see how the project can be made a profitable one.

"The fact that the company organized to construct such reservoirs by the act of the legislature referred to has not seen fit to take advantage of the extensive and valuable franchise granted to it, would seem to indicate that there are grave financial difficulties in the way of construction of storage reservoirs by private capital.

"It has often been said that the state should construct these reservoirs and in support of this contention it is very forcibly argued that the state is abstracting water from the river for the supply of the Erie canal; has placed obstructions in the river which are a menace to the city in time of high water and that it owes it to the people who are affected to protect their lives, health and property from floods, and that the dams will increase the assessable property of the state and largely benefit the state by the creation of additional water power.

"While these arguments are forceful, there are practical difficulties in the way of securing state aid, sufficient to construct the dams, aside from the arguments that would be urged by other sections of the state that this locality should not be singled out for so large an expenditure of public moneys.

"The constitution contains a provision which requires the expenditure of so large a sum of money as would be necessary to construct storage reservoirs adequate for the purposes mentioned to be submitted at a general election to the people and to receive a majority of all the votes cast for and against it at such an election.

"If a bill were introduced in the legislature providing for an appropriation for the construction of storage reservoirs for the Genesee river, it is quite likely that it would serve as an encouragement for the introduction of similar bills for other sections of the state and swell the prospective investment of the state beyond an amount which the people of the state would approve.

"Another plan which has not been fully developed or discussed is that of constructing storage reservoirs and levying the expense upon the property benefited thereby. It is a general practice of the state to confer upon municipal corporations the power to make public improvements and assess the costs upon the property benefited thereby. Thus municipalities have authority to construct sewers for the protection of public health and assess the benefits upon the territory that is, or may be, benefited thereby. These assessments extend not only to the property which is connected with the sewer but property which may be connected some time in the future. Cities are authorized to open new streets and assess the costs upon territory that may be benefited. Pavements are likewise constructed. The property which may be thus reached by assessment extends not merely to the tangible real estate, but may include any rights or interest in such real estate.

"These rights or interests would include water rights and franchises. A political division like a city or a county as well as an individual or a private corporation, may be assessed for these benefits. The state has brought itself within the jurisdiction of such assessments. By such assessments, therefore, all political divisions and all interests might be reached.

"The exact statute under which these assessments are to be brought about would be a subject for most careful study and discussion. The question of necessity should first be formally passed upon. The state commission, which has been appointed, will submit a report, which will serve as a preliminary report, and which might form the basis for the passage of an act creating a commission to file a formal and final report of storage reservoirs to protect the life, health and property of the people of the state affected. The present state commission might be continued for that purpose and it might report its findings upon the subject of the necessity to the courts.

"After the submission of such a report and its confirmation, the same or a new commission might then examine into the plans for the construction of reservoirs, the cost thereof and the estimated expense of maintaining the same, the area and interests to be benefited and the share of the expense which each interest

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should bear. The statute might provide that this report should then be submitted to the courts for approval or disapproval. On the hearing of the report as to the necessity for the construction of reservoirs and the assessment therefor all parties and interests could be heard.

"Should the second report be confirmed, the commissioners might then be authorized to issue bonds, the proceeds of which would be sufficient to carry out its plans. These bonds might be made a lien upon the property controlled by the commission and the bondholders would have the protection of the previous action of the courts upon the proceedings of the commission.

"When the reservoirs shall have been constructed the commission might proceed to levy from year to year the amounts necessary to pay the interest on the bonds, maintain the reservoirs, and provide for sinking funds to pay the bonds, which would be issued for a long period of years.

"It is believed that the vast amount of new property which would inevitably be produced by the proposed storage of waters would so materially contribute to the cost as to reduce the assessments upon present values to the minimum.

"These plans are merely suggested by the sub-committee on scope for discussion, with a view to aiding the city committee in arriving at some definite plan by which united action can be had.

"A. J. RODENBECK,
"DANIEL B. MURPHY,
"W. A. SUTHERLAND."

The above report will be presented to the state flood commission upon its visit to this city to-morrow and it is hoped the visiting officials will approve the plan suggested by Mayor Rodenbeck.

The report of the sub-committee on statistics, published in these columns yesterday, will also be turned over to the state commission.

This afternoon the local flood committee met with the flood committees of Geneseo and Mt. Morris at the Chamber of Commerce to discuss the mayor's plan of assessing the cost of the storage dam.

Report of the Sub-committee on Statistics, etc., to the General Committee appointed to co-operate with the State Water Storage Commission.

ROCHESTER, N. Y., *August* 14, 1902.

To the Hon. HENRY C. BREWSTER, *Chairman, and other members of the Committee.*

Your Sub-committee on Statistics, etc., begs leave to report as follows:

Previously to the meeting of your general committee, on July 23d, your chairman and Mr. Ocumpaugh sent out a large number of letters to people along the Genesee valley asking for information relative to damages from the flood, and also with reference to permanent marks of the flood.

Immediately after the meeting referred to, a general form of letter was drafted and sent to a large number of people in the territory damaged by the recent floods. The letter read as follows:

ROCHESTER, N. Y., *July* 30, 1902.

DEAR SIR.— Pursuant to the provisions of chapter 406 of the laws of 1902, Governor Odell appointed a commission to make investigations to ascertain the causes of the overflow of the various rivers and watercourses of the state and to determine what can be done, if any thing, to prevent such overflows.

In order to aid the commission in its labors, the mayor of the city of Rochester has appointed a local committee to investigate the conditions in the Genesee valley, where floods in years past and twice the present year have worked injury to persons and property, in the city of Rochester, in the many populous and thriving villages, and in the fertile agricultural lands in the counties of Monroe, Genesee, Wyoming, Livingston and Allegany. Streets and roads have been washed out; houses and bridges carried away, cattle and crops destroyed, the land stripped of soil and the

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streams turned into new channels, thereby destroying landmarks and rendering valuable arable lands totally useless for years for cultivation and grazing.

In view of the importance of the question, both to the individuals liable to damage and to the public, the undersigned, a subcommittee on statistics, etc., have thought it proper to address this letter to you and ask your aid in obtaining data which will be presented to the state commission and which may aid it in formulating a plan for the amelioration of the existing conditions.

The committee would like you to co-operate with it in obtaining, by observation or otherwise, the following information:

a. Location of high water marks.

b. Elevation of high water marks above low water, and referred to existing structures.

c. Location, dimensions, area, character and ownership of land overflowed.

d. Duration and maximum depth of overflow.

e. Character and amount of damage to crops.

f. Character and amount of damage to livestock.

g. Character and amount of damage other than to crops and livestock.

h. Names of persons who have information on the above questions, or who can give testimony before the commission.

Information on these matters will greatly aid the committee in their labors and may result in important measures for relief.

Answers may be sent to Mr. E. Ocumpaugh, Secretary, 89 Main street, East, Rochester, N. Y.

E. A. FISHER,
Chairman.
J. Y. McCLINTOCK,
E. OCUMPAUGH,
PIERRE PURCELL,
J. J. MANDERY,
H. S. WOODWORTH.

Extracts from replies thereto are as follows:

Mr. HERBERT WADSWORTH, *Avon, N. Y.*, referring to the damage says, "In the main the alluvial lands along the Genesee (and Canaseraga creek) are frequently flooded to a width estimated to average one mile. From Rochester to Dansville is called 50 miles; say 50 square miles subject to inundation. The wise farmer uses these lands for cattle pasture, for which purpose they should be estimated at $35 per acre. These lands include much permanent waste lands, just how much it is impossible to estimate, but for convenience the square mile may be called 600 acres of usable land. In 50 miles there are then 30,000 acres at $35 per acre — the land is worth for pasture, say, $1,000,000. Permanently guaranteed against inundation these territories would invite intensive cultivation and might be worth $150 per acre. This would entail expensive drainage, tilling and road making — (money in circulation). I do not know how more exact or persuasive figures could be made."

(Signed) HERBERT WADSWORTH.

Mr. Wadsworth also, in answering the questions, says that the duration of the overflow is generally three days, and that the character and amount of damage to crops was entire destruction. He also names persons who have information on the question, and who can give testimony before the commission, who are as follows:

Mathew Wiard, Avon.
William Markham, Rochester and Avon.
Stephen Hosmer, Avon.
Daniel Lacy, Avon.
Justus Williams, Avon.
George Dooer, Avon.
Charles H. Pierson, Avon.
Charles C. Hovey, Lima.
Mortimer E. Ross, Avon.
Charles House, Avon. (Canawagus.)

Mr. ALLISON C. VAN ALLEN, *of The Avon Herald*, in reply says, "Between the Fowlerville bridge and Markham's, east of the W. N. Y. & P. R. R., there appears to be about 1,200 acres of pasture, 800 of timothy and 1,300 acres of cultivated crops. Approximate value as it stood before the freshet — pasture at $5

an acre, $6,000; timothy at $10 per acre, $8,000; cultivated crops at an average of $20 per acre, $26,000; making a total of $40,000.

In addition there are fences, bridges and the removing of the top soil of many acres of fine lands, which of course would amount to several thousand dollars more.

I have noticed the highest point on the abutment of our bridge of '65 and that of March, last, and find that the recent freshet came within eight inches of the March record. I will see parties on the low lands and have them fix stakes so that the commission may get the record when they come.

Any other information you may suggest will be gladly given at the earliest possible moment.

(Signed) A. C. VAN ALLEN.

Mr. ELMER J. WILLIAMS, *Farmer, West Avon, N. Y.*, makes a sketch showing location of flooded area from the Erie R. R. to York, on the westerly side of the Genesee river. He says "The water was from eight to ten feet deep on the west side of the flats," and states damages sustained on various farms close by his place, but does not estimate the pecuniary loss.

Mr. L. A. ALLEN, *Superintendent Genesee Salt Company, Piffard, N. Y.*, says "The writer has been located at Piffard, N. Y. the past fifteen years, on the west side of the Genesee valley, overlooking a distance in said valley of nearly two miles, which at time of floods is entirely covered with water. The floods of 1902 have been the most destructive to the writer's knowledge, coming at a time when crops were well under way; the same being a total loss, besides washing the soil badly, leaving the land in such condition that further operations the present season is an impossibility. After a flood where crops have been under water, the odor of decay is not only disagreeable, but endangers the health of the inhabitants the entire length of the valley."

Mr. WM. A. BRODIE, *Manager for Wadsworth Estate, Geneseo, N. Y.*, writes "In reply to question (a) Freman Gilmore, proprietor of the flouring mill at Iron bridge in Geneseo can give accurate water marks, low and high, for many years.

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(b) Same reference.

(c) In the towns of Avon, Geneseo, Leicester, Groveland and Mt. Morris there are hundreds of acres in each town belonging to W. A. Wadsworth. In Avon, Herbert Wadsworth has several hundred acres which overflow. James S. Wadsworth and Craig W. Wadsworth have a thousand acres in Geneseo overflowed. J. W. Wadsworth has several hundred acres in Caledonia, Leicester and Groveland, Mt. Morris also, which are also annually overflowed. Mrs. Mary Wadsworth Chandler has several hundred acres in York in same condition.

(d) Cannot answer off-hand. Great depth in some places.

(e) In Mt. Morris, Leicester and Groveland, of my own knowledge, whole crop of beans, peas, corn and hay were entirely destroyed.

(f) In Mt. Morris our own farm, belonging to W. A. Wadsworth, thirty-eight steers were lost in March last, owing to rapid rise of water.

(g) There has been great damage by loss of soil and by obliteration of original boundary lines. At every flood the river changes, and good, arable land is lost to be replaced by worthless low land.

(h) In addition to the persons named above, I will add

W. W. Willard, Geneseo, N. Y.
Joseph Cameron, Mt. Morris, N. Y.
M. W. Long, Moscow, N. Y.
John F. White, Mt. Morris, N. Y.
Andrew Gardiner, Mt. Morris, N. Y.
W. S. Gardiner, Mt. Morris, N. Y.
Samuel Irwin, Mt. Morris, N. Y.
M. E. Ross, Avon, N. Y.

I could name dozens of others, but only mention those with whom I came in actual contact concerning the matter.

Mr. EDWARD P. WARD, *Attorney at Law, Geneseo, N. Y.*, wrote enclosing a clipping from the *Livingston Republican*, published in Geneseo, and taken from the issue of July 10, 1902. He says that "Permanent marks showing the height of the recent floods may be seen at the Gilmore Mill property adjoining the river and but a few rods distant from the Erie R. R. depot in Geneseo."

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The clipping states that "The flood of last March raised to a point within nine inches of the historical high-water mark of 1865," and also that "the high water of July last, reached a point four inches above the high-water mark of last spring and five inches below the record of 1865. The water remained stationary from about 3 o'clock Sunday afternoon until an early hour Monday morning, and then began to recede very slowly at first."

This statement is of interest from the fact that the high-water mark of the July flood at the Court street dam, in Rochester, was twenty inches lower than the flood of March 3d, referred to, while at Geneseo the water in July was four inches higher than the high water of March last. The loss is figured (in the clipping) between Sonyea and Geneseo, at $250,000, and states further that, all told, the damage in western New York will run well into the millions.

CHARLOTTE W. PATTISON, *Portage, N. Y.*, writes "With my sister I am the owner of a farm of ninety-four acres, situated on the Geneseo river; thirty-five acres of "flats" adjoining the river at the village of Portageville. Opposite my farm is a farm of 100 acres owned by Niel O'Donald. The morning of the flood his farm, my thirty-five acres, and river, was one lake. I estimate my loss at $1,300, and that of Mr. O'Donald at not less than $8,000."

Mr. J. E. MUNN, *Oramel, N. Y.*, gives the location of high-water marks at Oramel bridge, and says that one mile wide the entire length of the river bottom was overflowed. The duration of the overflow was three days, two to eight feet deep, according to the bottom.

The amount of damage to the crops in the town was $50,000, and to livestock, $1,000; bridges, $20,000; highways, $10,000; farms, $50,000; making a total of $131,000.

He says further, "The only thing to help the farmers out south of the bridge is to straighten the river and raise its banks. The river now has to travel at least three miles to get one, making it to cut across farms and making new channels. There is so much that can be done that it is difficult to name all."

Mr. W. S. MILLS, *Postmaster, Fillmore, N. Y., Township of Hume, Allegany County.* Mr. Mills says "The Genesee river at Fillmore is about seventeen feet above low-water mark. At the time of the Johnstown flood the river was eighteen feet above low-water mark; measurements made at the same pier of the river bridge. At flood of July 6th, the river was 150 feet wider, caused by washing away of the high bank at the time of last spring's flood and the one of July 6th. I am told by one of the oldest inhabitants that the river was nearly three feet higher than he ever knew it to be before. On July 6, 1902, at 11 a. m., all the lower river flats were submerged. Duration of the overflow was about twenty-four hours. All crops destroyed. I have heard of a few instances where horses, cattle and hogs were drowned; but the loss of livestock is not large. Other losses were sustained by almost entire loss of fences, damage to a few buildings and washing away of land by the changing and widening of the channel.

About eight inches of water fell between the hours of 8 p. m. and 3 a. m., on July 6th. Some claim seven inches and some eight. Measurements were taken from empty milk cans fully exposed to the rain. The greatest part of damage to the township was from creeks and small streams. Town lost sixteen bridges, all iron but two, and one flour mill that had stood on the same foundation for nineteen years was washed away."

He refers for further information to the following reliable men who have long resided in the vicinity:

Geo. E. Minard, Fillmore, N. Y.
Uriah Stone, Fillmore, N. Y.
Delos Bengamine, Fillmore, N. Y.
L. D. Reynolds, Rossburg, N. Y.
Aug. Goodrich, Mills Miils, N. Y.
H. C. Brown, Hume, N. Y.
F. I. Campbell, Wiscoy, N. Y.
D. D. Gilbert, Rossburg, N. Y.

Mr. F. B. DODGE, *Postmaster, Mt. Morris, N. Y.*, says "I have made a canvass of the losses caused by the recent flood — I have covered a territory of about eight miles in length, extending from Jones bridge to almost one mile south of the Sonyea Colony. The losses will amount to at least $235,000 in this territory."

Dr. WILLIAM P. SPRATLING, *Craig Colony, Sonyea, N. Y.*, sent a map of the Craig Colony grounds at Sonyea, and indicated the portion of their lands that were damaged. He says the water on the flats reached a point about eight feet above the normal level.

Extracts from the local papers, relative to the July flood, are herewith attached.

Mt. Morris Enterprise, July 9, 1902; *Livingston Democrat*, July 9, 1902, July 16, 1902; *Mt. Morris Union*, July 31, 1902.

Rochester *Union and Advertiser*, March 3, March 4, March 5, July 7, July 8, July 9, and July 10, 1902, relative to both floods.

FLOOD OF JULY 6, 1902.

STATEMENT BY MR. HERBERT STULL, ROCHESTER, N. Y.

(1) *Town of Rush.*

Farm owned by Mrs. H. S. Budlong, Adam Eye, tenant, adjoining the "Stull Farm," contains 408 acres, planted with potatoes, beans, etc. Flood practically destroyed whole crop and washed away surface soil.

Say 400 acres at $10 ..... $4,000 00

(2) *Scottsville.* Helen S. Budlong Farm. 200 acres.

190 acres of hay destroyed 2,000 00

(3) South of the "Eye" farm to Livingston county line, 800 acres of hay, two tons to acre.

1,600 tons at $15 ..... 25,000 00

(4) Stull Farm — *Town of Rush.*

60 acres flooded — 30 acres of crops.

60 acres at $10 ..... 600 00

(5) West side of Genesee river, between Scottsville and bridge at Avon. Search farm.

800 acres at $10 ..... 8,000 00

Total $45,000 00

The committee is also under great obligations to his honor, the mayor, for a personal investigation made at Mt. Morris and Geneseo, a full record of which was made in the form of an examination of the property owners who could give reliable information relative to the damage; the full report of which is hereto attached. The following named persons gave information:

T. L. Hall, Geneseo, N. Y.
Arthur Cummings, Geneseo, N. Y.
Willis Willard, Geneseo, N. Y.
Frank Hagen, Geneseo, N. Y.
Jos. Blair, Geneseo, N. Y.
Jas. Haley, Geneseo, N. Y.
John McKay, Geneseo, N. Y.
John Kelley, Geneseo, N. Y.
Jas. Calihan, Geneseo, N. Y.
Michael Donohue, Geneseo, N. Y.
Wm. Ewell, Geneseo, N. Y.
Chas. Marsh, Geneseo, N. Y.
Mina Averill, Geneseo, N. Y.
Chas. Werner, Geneseo, N. Y.
H. B. Dodge, Geneseo, N. Y.
Louis Chattman, Geneseo, N. Y.
Geo. Rice, Geneseo, N. Y.
Moffat & Lang, Geneseo, N. Y.
Neff & Neff, Geneseo, N. Y.
Edw. Henrietta, Geneseo, N. Y.
Fred Nexon, Geneseo, N. Y.
Broffatt & Worcester, Moscow, N. Y.
John C. Brown, Piffard, N. Y.
Teall & Fitzgerald, Geneseo, N. Y.
Holden & Colbin, Geneseo, N. Y.
Wm. Mann, Wadsworth, N. Y.
John Rossburg, Piffard, N. Y.
Jas. Filmore, Piffard, N. Y.
Samuel Finley, Geneseo, N. Y.

and a summary of the damages that these persons sustained, and other persons in the immediate vicinity, of which they had personal knowledge, was about $200,000. The gross amount of damages, as estimated in the testimony and letters was about $800,000.

DAMAGES IN ROCHESTER.

The July flood did very little damage in the city, the elevation of the water at the dam being nearly two feet lower than that of the March flood. The March flood, however, was the cause of a large amount of damage, and had it not been for the prompt action of the assistant superintendent of public works in putting

in a temporary dam at the Clarissa street bridge, the damage might have been very serious, both to the canal and to the city. The actual damages consisted in the filling of the cellars of buildings along Exchange street, from Hubbell park to the Erie canal, from an overflow of the river into Exchange street. This water also gorged the Exchange street sewer which empties into the outlet sewer passing through Main and Front streets. Other damages by the same flood were the filling of nearly all the cellars on Front street and a large number on the east side of Mill street, from the overflow of the river between Main and Andrews streets into Front street.

Considerable damage was also occasioned by the flooding of cellars on Main street, due to the outlet sewer in Main and Front streets becoming surcharged and thus forcing the waters into these cellars.

The appended map of the city shows the elevations of the water in various parts of the city, and also the area where damage occurred.

Mention should also be made of the break in the river bank south of the Erie R. R. by which the water from the river flowed into the Erie canal feeder on the east side of the river. This water was prevented from entering the canal by an ice gorge at its entrance, and overflowed the feeder banks on the easterly side and did a large amount of damage to the property in Mt. Hope avenue and adjacent property between the Erie canal and Clarissa street.

The city was also in great danger from an overflow of the river into the former Genesee valley canal now occupied by the tracks of the Pennsylvania R. R. Company. The water at the bend above the Vacuum Oil Company came within a very few inches of the top of the narrow embankment between the main track of said railroad and the river. An overflow at this place would have done a large amount of damage to the westerly part of the city.

While it is not the province of this committee to suggest remedies, it may be proper in this connection to call special attention to the fact that the great danger to the city from floods

such as occurred in 1865 comes from constructions which are owned or controlled by the state. The damage done on the easterly side of the river, and the danger of very great damage to the eastern part of the city, is occasioned by the presence of the Erie canal feeder extending from the dam at the rapids to the Erie canal, a distance of about two miles.

On the westerly side of the city mention has also been made of the danger to that portion of the city by an overflow into the former Genesee valley canal. The control of this property, so far as necessary to protect the city, is believed by us to be in the state.

Another serious menace is the Erie canal aqueduct. The commissioners investigating the 1865 flood in their report point out that the piers supporting this structure, instead of being built parallel with the stream, run partially across it, thereby materially increasing the amount of obstruction. The commissioners also point out that during the flood trunks of trees, logs and timber lodged against the aqueduct and closed a considerable portion of the waterway through the arches. The situation is illustrated in the report of Mr. Rafter to the state engineer in the year 1896.

In this connection attention is called to a profile of the Genesee river, from the upper falls to the dam at the rapids. This profile shows a line representing as near as can be ascertained the elevations of the water in the flood of 1865. This line shows the result of an investigation in 1893 by Mr. J. Y. McClintock, now commissioner of public works, of the reported high-water marks of 1865. Other data relating to floods in 1873, 1879, 1893 and 1894 are also shown, together with profile of the high-water of 1896 and March, 1902. There is also attached a map of the city, on a scale of 1,200 feet to the inch, on which is shown elevations of the high water of March, 1902, together with a shaded area where damage occurred.

MAXIMUM FLOOD FLOW OF THE GENESEE RIVER AT ROCHESTER.

The chairman of your committee in 1896 co-operated with Mr. Emil Kuichling, civil engineer, in an estimate of the maximum flow of the river in the April flood. The maximum flow was estimated by us at 36,000 cubic feet per second. As the river in the March flood of this year was at almost exactly the same height, the flow may be taken at about the same quantity.

ELEVATIONS OF THE RIVER AT COURT STREET DAM.

Daily elevation of the river at the Court street dam have been taken by this office since 1893, and a table showing the maximum and minimum, and average monthly elevations since that time, is appended hereto, together with a diagram showing the maximum monthly elevations for the same time; also a diagram showing the hourly elevations of the water at the March and July floods of 1902.

FLOOD MARKS.

Elevations of the high water, in both the March and July floods, at various points in the city, have been taken. Marks of the floods along up the Genesee valley have been preserved so that elevations of them can be taken, when desired. The division engineer of the Pennsylvania R. R. has noted the elevations of the high water along that railroad.

DAMAGES TO RAILROADS IN THE GENESEE VALLEY.

The Rochester division of the Pennsylvania R. R. (the former Genesee Valley Canal Railroad), was by the terms of its charter built substantially along the line of the Genesee valley canal, from Rochester to Hinsdale.

The canal closely followed the river valley, from Rochester to Mt. Morris, a distance of about thirty-seven miles, and the valley of the Canaseraga and Kishaqua creeks, tributaries of the Genesee river, from Mt. Morris to Portage gorge, about seventeen miles; from Portage gorge to Oramel, a distance of about twenty-three miles, the canal was built along the westerly side of the river valley, and from Oramel to the summit, a distance of

about twelve miles, the river canal followed generally along the course of the Black creek and other tributaries of the Genesee river.

The damage to this railroad, both to its roadbed and by interruption of traffic, was large in both the March and July floods, but more especially in the July flood. Traffic was entirely suspended for fully one week. The tracks were overflowed by the river in numerous places from Genesee Junction to Mt. Morris. The damages to the roadbed, however, were not serious in this section. Some damage occurred near the Erie railway bridge in the Portage gorge by the washing away of a retaining wall at the foot of an embankment by the Genesee river.

The river also took away portions of the roadbed between Fillmore and Oramel. The greatest damage, however, was probably occasioned by the streams tributary to the Genesee river.

The proposed dam at Portage, described at length in the report of Mr. Rafter to the state engineer and found in the State Engineer's Report of 1896, would set the water back to a point between Houghton and Canadea, and would cover the territory along the line of the Pennsylvania Railroad, where the greatest damage occurred. The line between the points in question, in case the dam was built, would be located at a higher elevation and beyond the reach of future floods.

The Erie Railway's Rochester branch was overflowed between its station and Clarissa street bridge, in the city, and traffic suspended for several days in both the March and July floods. Considerable damage was also done to the western division, from Scio to Belvidere.

The Lehigh Valley Railroad was also interfered with in the city between its station and Clarissa street bridge.

The Buffalo, Rochester & Pittsburg Railroad also suffered damage along tributaries of the Genesee river, on some portions of its line.

GENESEE RIVER FLOODS.

Mrs. Jenny Marsh Parker, in her book entitled "Rochester, a Story Historical," on pp. 370 and 371, states that "the early settlers learned from the Indians that about '1805 a great flood

did occur, occasioned no doubt by the accumulation of ice at Avon,' thus setting the water back on the Genesee flats." Speaks also of one in 1835, 1857 and 1865.

In regard to the flood of October, 1835, Mr. W. F. Peck, in his book entitled "History of Rochester," states that "Mr. Harvey Ely, a former citizen of Rochester, estimated the quantity of water flowing at about 36,000 cubic feet per second."

This is also referred to by Mr. George W. Rafter, who also speaks of report of F. C. Mills relative to Genesee valley canal, Assembly Document No. 73, 1837, page 69.

In 1857, February 8th, the river rose carrying away the greater part of the old bridge across Main street.

The great flood of 1865, March 17th, is mentioned in both Mrs. Parker's and Mr. Peck's books, and on page 640 of Mr. George W. Rafter's report to the state engineer in 1896, is spoken of at length. "The estimated damage to property is stated, in Rochester newspapers, to have exceeded $1,000,000."

In connection with this great flood reference is made to the report of the Flood Commission of 1865, whereby certain commissioners, citizens of Rochester, were by legislative enactment appointed to "inquire into and ascertain the cause or causes of the inundation of the city of Rochester by the water of the Genesee river, and what measures were necessary and proper to guard against or preventing a recurrence of such an inundation." See pages 642-644 of State Engineer's Report for 1896, and Assembly Document No. 117, Session of 1866. (In University Library.)

The common council of the city of Rochester, through a special commission termed "River Committee," reported to the common council as to the most practicable and economical measures to provide a sufficient channel for the Genesee river through the city of Rochester and prevent damage by floods. See Report of Common Council, 1865-1866, pages 217-221.

This committee presented two plans:

(1) To guard against the flooding of the *feeder and the Genesee valley and Erie canal.*

(a) By removing the unused guard lock to a position further south of its then location and erection of a wall on the west side of the river, from Johnson dam to high ground near the foot of Edinburgh street.

(b) Another archway in the aqueduct and quarrying out of river bed above and below aqueduct.

And (2) Excavating a tunnel in the river bed extending from a convenient point above the foot of the falls on the west side under Front street, or the river, to a point between Main street bridge and the aqueduct.

This tunnel scheme was originally suggested by the legislative commission as reported in Assembly Document No. 117, Session of 1866. Copy of this in University Library as follows: "To make an excavation in the bed of the river, from brink of falls to a point midway between Main street and aqueduct," such excavation to be seventy feet on top and fifty feet on bottom, with a depth of fourteen feet at brink of falls and six feet at its south end.

Gen. I. F. Quinby, the expert engineer of this commission, recommended the following work as a means of protection:

(1) Increase the area of openings in the embankment of the B. N. Y. & Erie Railroad, from Canawaugus to Avon.

(2) Construction of a revetted dyke across the head of gorge, between Genesee Valley canal and Genesee valley railroad bridge.

(3) Removal of all obstructions in and about the east arch of Main street bridge.

(4) Construction of wall over coping south end of Main street bridge, and of a wall from west bridge abutment to Chapin's Mill.

(5) Cutting of openings in lower and upper dams equal in length to one-half length of dam.

(6) Removal of the portion of old aqueduct jutting out into river.

(7) Construction of detached fenders above aqueduct and Main street bridge.

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(8) Wall above Genesee valley canals, etc.

The report is given in full in the appendix.

WATER-WAY AREAS.

Mr. George W. Rafter, in the State Engineer's Report of 1896, gives the following table as the area of the bridges and the Erie canal aqueduct in this city.

(1) Aqueduct . . .	4,308.30
(2) Court street bridge	5,081.00*
(3) Main street bridge	3,367.00
(4) Andrews street bridge	4,511.00
(5) Central avenue bridge	4,450.00

The foregoing data relative to floods in the Genesee valley were collected by Mr. William N. Radenhurst, Water Works Assistant Engineer.

RAINFALL.

The report of the Weather Bureau at Ithaca gives the rainfall at the following places on the Genesee river watershed, beginning with February 28th and ending with March 3d, 1902, as follows:

	Feb. 28.	March 1.	March 2.	March 3.
Angelica	0.55	0.51	0.19	0.07
Atlanta	0.33	0.38	0.40	0.05
Avon	. . . .	0.21	0.35	. . . . .
Bolivar	0.74	0.31	0.18	0.23
Hemlock Lake	0.30	. . . .	0.31	. . . . .
Nunda	. . . . .	0.20	0.13	. . . . .

It will be seen that the flood of March was due almost entirely to the melting of snow and not to an excessive rainfall.

Copies of said reports are hereto attached.

*This is the opening of the river arches below the level of the flood of 1865; in addition the arches over the Johnson and Seymour raceway have an opening of 790 square feet and the Erie canal arches of 498 square feet.

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RAINFALL OF JULY FLOOD.

The rainfall for the July flood, beginning with July 3d and ending with July 6, 1902, at the same places, is as follows:

	July 3.	July 4.	July 5.	July 6.
Angelica	0.63	.....	0.66	4.50
Atlanta	0.52	.....	0.77	1.58
Avon	0.30	.....	0.43	2.01
Bolivar	1.84	.....	0.66	1.66
Hemlock Lake	0.42	.....	1.39	2.44

The weather report for July has the following note with reference to the precipitation in June and July, 1902:

"The precipitation for June and July, 1902, was very excessive, amounting at a few stations to nearly fifty per cent. of the annual precipitation. The annual rainfall for New York, averaged from records of stations with normals, is 37.81 inches. By referring to the above chart it will be seen that the total precipitation for the two months in question amounted to twelve inches or more over more than half of the state, and fifteen inches or more in a considerable section of western and also in parts of eastern New York, while eighteen inches or more were reported in parts of Allegany county."

A copy of the weather report for July is also appended.

This report is limited generally to conditions in the Genesee river, from Rochester to Belfast, a distance of about eighty miles. Damage from water in this territory was caused by the flood flow of the river, and not by excessive rainfall upon the territory itself, as was the case in much of the higher territory on smaller streams tributary to the river.

The gross estimate of damages that occurred in the portion of the Genesee valley covered by this report has been previously stated at $800,000. The large damage to the railroads, both from the destruction of the roadbeds and the interruption of traffic, have not been included, nor any loss to the general public adjacent to the flooded area from cutting off for a long time the use of the traveled highways.

The total damage, therefore, in and adjacent to the territory flooded would be much larger than has been stated.

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It has been the purpose of your committee to confine the report to damages, the cause of which, to some extent at least, is subject to control.

Estimates of the influence upon the flood flow of the Genesee river of storage dams in the Genesee valley can be found in the Annual Report of the State Engineer and Surveyor for the fiscal year ending September 30, 1894, at pages 390 and 393, and also in the report for 1896, pages 720-726. Other statistics relative to the horse power of the Genesee river may be found in the 1896 report referred to.

Attention is again called to the exhibits hereto appended, viz:

No. 1. Table giving elevations of the Genesee river at Court street dam in Rochester.

Nos. 2, 3 and 4. Views showing conditions existing in Genesee river on March 3d, 1902.

No. 5. Extracts from *Mt. Morris Enterprise* and *Livingston Democrat*, July 9, 1902; *Mt. Morris Enterprise*, July 16, 1902, and *Mt. Morris Union*, July 31, 1902.

No. 6. Extracts from *Union and Advertiser*, Rochester, of March 3, 4 and 5, and July 7, 8, 9 and 10, 1902.

No. 7. Map showing elevations of high water in city and approximate territory flooded. (Plate II.)

No. 8. Diagram showing hourly elevations of the Genesee river at Court street dam during floods of March and July, 1902. (Plate III.)

No. 9. Diagram showing monthly maximum elevations of the Genesee river from March, 1893, to August, 1902. (Plate IV.)

No. 10. Profile showing elevations of the flood flow of the Genesee river in 1865, 1873, 1879, 1893, 1894, 1896 and 1902. (Plate V.)

No. 11. Weather bureau report for February, 1902.

No. 12. Weather bureau report for March, 1902.

No. 13. Weather bureau report for July, 1902.

No. 14. Testimony taken at Mt. Morris and Geneseo July 31 and August 1, 1902, by Mayor Rodenbeck and E. Ocumpaugh, relative to damages by flood.

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In addition to the foregoing we offer, by permission of Mr. Rafter, *Exhibit No.* 15, being a report of George W. Rafter, engineer in charge of the Genesee River Storage Surveys.

No. 16. High water mark along Pennsylvania Railroad.

No. 17. Report of river committee, 1866.

Respectfully submitted,

E. A. FISHER,
Chairman.
J. Y. McCLINTOCK,
E. OCUMPAUGH,
PIERRE PURCELL,
J. J. MANDERY,
H. S. WOODWORTH.
Sub-committee on Statistics, etc.

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Exhibit No. 1.

Table giving the maximum, minimum and mean monthly topographical elevation of the Genesee river at the Johnson and Seymour dam from March 1, 1893, to December 31, 1900.

NOTE.— The topographical elevation of the crest of the Johnson and Seymour Dam is 241.91.

MONTH.		1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
		Elev.	Elev.	Elev.	Elev.	Elev.	Elev.	Elev.	Elev.	Elev.	Elev.
January	Maximum	.....	244.86	243.33	243.55	244.08	245.44	245.85	246.37	244.15	242.85
	Minimum	.....	242.23	241.28*	241.70*	241.15*	240.45*	242.15	241.85*	241.95	241.70
	Mean	.....	243.15	242.35	242.30	242.34	242.92	243.38	243.02	242.69	242.22
February	Maximum	.....	244.93	242.31	244.58	242.91	246.15	244.15	244.85	242.20	242.90
	Minimum	.....	242.12	240.81*	242.23	241.42*	242.08	241.85*	242.00	241.45*	241.50
	Mean	.....	242.97	241.42*	243.12	242.50	243.37	242.45	243.29	241.84*	242.03
March	Maximum	246.41	247.04	245.24	246.96	246.13	245.55	245.17	245.65	247.45	249.55
	Minimum	241.93	242.54	243.09	242.44	242.29	242.72	242.84	242.60	240.80*	242.80
	Mean	243.53	244.22	243.66	243.70	244.09	243.81	243.41	243.59	244.16	244.84
April	Maximum	244.65	246.08	243.26	249.47	244.20	245.25	244.92	245.65	247.70	245.85
	Minimum	241.95	242.66	242.34	242.49	242.67	242.28	242.55	242.80	243.95	242.35
	Mean	243.27	244.12	243.59	244.59	243.12	243.09	242.21	244.10	245.22	243.31
May	Maximum	245.78	248.34	242.43	242.49	243.86	243.85	243.09	242.70	245.55	243.15
	Minimum	241.76*	242.34	241.88*	241.50*	242.15	242.37	242.02	241.80*	242.35	241.90
	Mean	243.15	245.50	242.23	242.09	242.63	242.82	242.34	242.29	243.08	242.26
June	Maximum	241.68*	245.20	242.28	243.12	242.22	242.57	242.11	242.00	245.15	242.85
	Minimum	239.96*	242.06	239.22*	241.66*	239.65*	241.82*	239.42*	240.20*	243.20	241.75
	Mean	240.80*	243.05	241.78*	242.14	241.26*	242.16	240.92	241.27*	242.95	241.97
July	Maximum	240.88*	242.17	241.99	242.18	242.71	242.27	241.10*	241.30*	242.30	247.70
	Minimum	239.28*	240.24*	239.18*	239.61*	239.69*	239.30*	239.05*	239.30*	240.85*	242.57
	Mean	239.95*	241.33	240.28*	241.94	241.50*	240.70*	240.03*	240.20*	241.80*	244.45
August	Maximum	244.40	242.13	241.77*	242.30	242.50	243.53	239.40*	241.55*	243.15	.....
	Minimum	239.18*	239.85*	239.18*	239.28*	239.13*	241.15*	238.86*	239.15*	239.70*	.....
	Mean	239.67*	241.39*	240.30*	240.69*	239.64*	242.20	239.10*	239.69*	241.63*	.....

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September	Maximum	243.68	245.18	241.71*	240.73*	240.40*	241.99	240.27*	241.00*	243.10	.....	
	Minimum	241.03*	239.26*	239.02*	239.08*	238.95*	240.12*	238.85*	239.05*	241.45*	.....	
	Mean	242.12	241.86*	239.43*	239.51*	239.32*	241.08*	239.25*	239.54*	242.18	.....	
October	Maximum	243.43	243.52	239.88*	245.55	240.27*	243.60	240.38*	241.30*	241.90*	.....	
	Minimum	240.50*	240.98*	239.01*	240.95*	238.85*	240.20*	239.00*	239.00*	239.65*	.....	
	Mean	241.81*	241.85*	239.23*	242.59	239.22*	241.71*	239.51*	240.09*	240.94*	.....	
November	Maximum	243.65	243.16	242.57	242.92	242.71	245.55	242.36	246.23	242.90*	.....	
	Minimum	241.43*	242.16	239.25*	240.91*	238.83*	242.06	240.05*	240.48*	239.60*	.....	
	Mean	242.09	242.61	240.83*	242.06	240.69*	242.87	241.60*	242.25	241.09*	.....	
December	Maximum	246.36	242.85	245.29	244.18	243.75	245.85	243.75	244.69	246.25	.....	
	Minimum	242.26	240.96*	239.11*	239.05*	241.39*	241.45*	240.69*	242.15	241.75*	.....	
	Mean	243.44	242.22	241.53*	242.16	242.19	242.63	242.36	243.05	243.11	.....	
For the year	Maximum	246.41	248.34	246.26	249.47	246.13	246.15	242.71	243.61	244.32	.....	
	Minimum	239.18*	239.26*	239.01*	239.05*	238.83*	239.30*	240.61*	240.87*	241.27*	.....	
	Mean	241.98	242.85	241.38*	242.21	241.54*	242.45	241.47*	241.87*	242.57	.....	

* Indicates that elevation of water is below crest of dam. † High water of April 1, 1896.

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Exhibit No. 5.

[*Mount Morris Enterprise, Wednesday, July* 9, 1902.]

A DELUGE.

MOST DESTRUCTIVE FLOOD EVER KNOWN.—NOTHING EQUALS IT IN THE HISTORY OF THE GENESEE VALLEY.

Loss in Western New York in the Millions.—In This Valley Half a Million Dollars.—Many Farmers Ruined.—From Dansville to Rochester the Valley a Lake.—Winters & Prophet's Loss $35,000.—*No Trains on Pennsylvania Railroad.—John F. White's Loss* $20,000.—*Millions of Worms.*

The down pour of rain of Friday night and Saturday including cloud bursts south of this valley, added to the creeks and river at full bank from the heavy rains of three days before, destroyed all boundaries of creeks and Genesee river and over the banks the waters spread in every direction, sweeping from the face of the earth hundreds of thousands of acres of farm lands covered with fine growing crops consisting of onions, beans, peas, wheat and oats, and the hay crop in the act of being harvested. The destruction of property is simply appalling and inestimable. Added to the loss of growing crops, is the destruction of fences, buildings and the washing away of the subsoil.

In addition to this comes a heavy loss to towns sustained by the washing out of highways, sluices and bridges increasing the taxes and adding additional burdens to farms laid waste by the flood.

The railroad companies in this valley will suffer great loss by the washing out of the tracks and the destruction and damage to bridges.

In this town the loss is appalling and will partially or wholly ruin some of our farmers. It comes so late in the season that there is no opportunity to replant with some other crop.

Winters & Prophet found on examining their lands that were flooded, after the water had receded, that their loss is far in excess of their gravest fears and that one thousand acres of late peas, which would have been not only an excellent yield but of very fine quality, entirely destroyed, and their loss placed at a

very low estimate is $35,000. This includes their pea crop for their canning factory at Geneseo. Aside from the loss of the entire crop of late peas, which they would have begun harvesting this week, their sweet corn crop is quite a heavy loss in addition. This is a terrible blow to this industry and will not only be felt by the proprietors but also by the laboring people who will be thrown out of employment. The loss to Winters & Prophet even exceeds the actual loss of crops, as they will not be able to fulfill contracts made. It don't seem possible that the parties could or would hold them responsible for failure in the destruction of property by the elements, or an act of God. Their factory in Geneseo is closed; here they will pack for a few days, peas raised on land not flooded.

Mr. B. Sweet has 125 acres of corn and wheat washed away. His farm is on the south bank of the Genesee river and a portion of the river is running through it, not only destroying his crops, but with the earth soft and under cultivation, has swept the subsoil away, making the land almost valueless. In addition to this his fences have been carried away and his large red barn undermined and turned on its side. Mr. Sweet's loss of crops, buildings and farm will amount to $10,000.

The loss of Mr. Geo. White and his son John will amount to over $8,000; they have 500 acres of grass, wheat, beans, peas and oats submerged, and in several places on their farm a good stiff current was running.

Mr. Ed. Sickles had twenty-three acres of sugar beets washed away on the Whitmore flats up the river, besides he has fifty-four acres of beets and corn, all of which is probably a total loss and for which land he pays money rent.

Messrs. C. P. and A. C. Olp own fifty-six acres of land on the flats, consisting of grass, corn, oats and peas wholly under water; the crop will be nearly a total loss.

Fred Williams, on the Bingham farm, will lose his crop of grass, some 100 acres, and how much of his wheat is damaged he cannot determine now.

Many of our farmers on the high lands will experience considerable loss by washouts in ditches on the farm and the daily wetting of their hay crop.

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The Mt. Morris Water Power Company will not lose but little from damage by water; their greatest loss is from delay and suspension of work.

Mr. F. C. Simerson has 140 acres of grass, corn, beans, wheat and peas under water, and the loss will amount to $2,500.

Mr. Daniel Heylmun has ten acres of beans and wheat flooded; the eight acres of beans will be a total loss.

Fifteen acres of the Wisner land on the flats, in charge of C. W. Gamble, all grass, is ruined.

Charles Dukelow's eight acres of corn on the flats was in eight feet of water Monday.

David Cameron on the Wadsworth farm on the flats is a very heavy loser.

Mr. Jas. Kyle on the flats will lose the crops on about 100 acres.

Robt. McKay had nine acres of corn destroyed.

P. J. Kingston will lose two acres of corn.

Mr. John F. White, of Leicester, is the next heaviest loser, estimating his loss at $20,000. He has a loss of 350 acres of peas, and 500 acres of corn under water, but believes that the corn will not be a total loss. He will also suffer loss on other farm products.

John Caten, of Leicester, will lose the entire crop of peas, beans, oats and wheat on 150 acres. He has nothing to feed his stock, and has sent his horses and cattle to Mr. White to have them fed, and has gone to work by the day for a farmer on the upland.

James Shefflin has 160 acres of peas, beans, wheat and oats under water and they are a total loss.

Bates Wooster, at Cuylerville, has 150 acres of grain and grass under water and his whole crop is ruined.

Among other farmers in Leicester, whose farms were under water and on which the farm products will be nearly a total loss, are William Cummings, 240 acres, large acreage of beans; W. J. Barrett, 200 acres; McLain Bros., 250 acres; Richard Welch, about 100 acres.

At Tuscarora the Kishaqua creek circled around Slaight's flat land above the village, washed out the Pennsylvania railroad for

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ninety rods, cut down through Creveling's warehouse, a strong current ran through the lower floor, down through the village, washing out gardens and filling cellars.

Wm. Hoffman who pays money rent for the Kysor farm had fifty acres of beans and corn destroyed and the loss is one he can ill afford.

Wm. Bevier, merchant, had his cellars at the store and house filled with water Sunday morning, and the damage to the contents will amount to four hundred dollars.

J. D. Kuhn, Mayhue, Wm. Narregan, Mrs. Davidson and Peter DeMocker, residents of Tuscarora, all had their cellars filled with water.

J. W. Butzer, telegraph operator at Tuscarora, had his cellar filled with water and garden washed away.

John W. Slaight will lose nearly his entire crop on his farm at Kysorville and estimates his loss at $1,500.

Mr. Pius Kapprell suffered some loss although most of his farm is on up land and out of the water.

Roy Leavy, on the Slaight farm, which he works on shares, is a heavy loser for his means.

John Slaight, of West Sparta, had fifty acres of beans and corn flooded at Tuscarora.

About fifty feet of the approach to the Tuscarora bridge was washed away.

M. Powers' lands were flooded and his loss is quite a good deal.

Craig Colony loss was slight. Ten acres of potatoes were washed away and the Kishaqua creek cut some ugly channels through the farm.

The Cone farm, rented by Mr. Brisbee in Groveland, has 150 acres of beans and corn under water and crop ruined.

J. S. Cooley, of Groveland, will suffer some loss by reason of the high water.

Mr. P. W. Green's farm on the flats is under water and his crops ruined.

The Cannons have a number of acres of growing crops under water.

Andrew Gray's farm is partly under water.

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L. J. Prettyjohn, of West Sparta, had forty-nine acres of onions and vegetables covered and he thinks it is a total loss. He was here Monday morning looking after celery plants to be set out on the flooded land.

Dr. Watkins, of West Sparta, had forty acres of beans ruined.

The McMaster and Moffett farms were flooded and crops ruined.

The Pa. railroad, between here and Olean, have a dozen washouts and a number of bridges that will require a good deal of an outlay to repair. Their loss will probably reach $100,000 or more. Superintendent Belle came here yesterday in his private car, left it at the station and hiring a livery team has driven south to inspect the damages. All traffic on this road suspended on Sunday, and it is probable none will begin before next week.

The D. & M. railroad is laid up for repairs; sixty feet of trestle is washed out at Sonyea, the track under water in the swamp and badly washed, and a portion of the track under water opposite Mr. Chas. McNair's farm in this town. Will not be able to run before the last of the week.

Three hundred Italians are working on the Pa. railroad at Portageville.

Among the farmers near Geneseo who lease lands of the Wadsworth's the following persons are losers: Freeman Lang, 30 acres of standing hay; Samuel Finley, 25 acres hay, and 20 acres corn; F. Hagen, 60 acres corn, 15 acres peas, 18 acres oats; W. Willard, 30 acres peas, 30 acres sweet corn; Ed. Rice, 20 acres hay; John McCaughey, 12 acres oats, 8 acres hay; James Haley, 15 acres hay; Mrs. Chandler, 100 acres hay; Congressman J. W. Wadsworth, 100 acres hay; Jas. S. Wadsworth, $2,500 in corn, hay and beans and a $300 fence.

At Arcade a cloud burst occurred at 2 o'clock in the morning, turning the streets into rivers and carrying away a large amount of property, the damage being estimated at $100,000. The Rev. Conrad, a Baptist minister, saved several lives by rushing to peoples' houses and warning them of the danger; the fire department worked heroically to save the lives of the people. One house was swept away, after repeated but futile efforts to save

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the inmates, and Miss Looper was drowned. When last seen she was in the upper story window crying for help.

At Nunda, the Kishaqua creek was in a rage and did a lot of damage. The State street bridge was washed away, and other bridges over this stream were damaged; the electric light plant was under water and the town in darkness, and many acres of beans and potatoes destroyed.

At Fillmore, water was four feet deep on Main street, the houses and contents of R. Cranford and E. A. Phillips swept away, together with a number of barns and outbuildings. All the cellars in the village were filled with water and damage in the aggregate very heavy.

At Warsaw the damage is estimated at $100,000, the Oatka creek overflowing, sweeping away bridges and stables; the electric plant was submerged and the town in darkness; farmers are among the greatest losers.

The village of Pike was under four feet of water; the water carried away blacksmith shop, market, store, post-office and warehouse besides bridges and sluices.

At Portageville a number of cellars were filled with water, Jewett's livery barn washed away and a good deal of damage done to the crops on the flat lands.

At Wiscoy and Mills Mills, two grist mills, furniture factory, planing mill, saw mill, several residences and a number of barns were swept away.

The villages of Hume and Wiscoy suffered great loss, and the total loss in Wyoming county is estimated at a quarter of a million dollars.

The onion and celery growers of South Lima will lose seventy per cent. of their crop and will financially embarrass many of the farmers.

Among the heavy losers at Portage on farm lands deluged are, Mrs. L. W. Pattison, Messrs. Brogan and O'Donald.

Several highway bridges in Poags Hole south of Dansville, on Canaseraga creek, were carried away.

At Hume, the post office, two residences, harness shop and iron bridge were washed away.

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The heavy soaking rain and especially the flooded farm land, have brought to the surface of the earth millions and millions of earth worms, and the stench from these dead worms is sickening.

There is no doubt, whatever, but what the damage wrought in the Genesee Valley by this flood will far exceed in money value the losses sustained in the spring flood of 1865. The flood in 1865 wrought sad havoc in Rochester and the stream swept away buildings, timber and cattle, but this July flood comes just before harvest time and wipes off the face of the earth a large share of all crops planted, tilled, and ready for harvest, and so late that no other crops can be substituted, so the loss of the use of the land is total besides the entire crop. It is a gloomy outlook for the farmers of all flat lands, and a loss that they will not recover from in many years.

[*Livingston Democrat, Issue July* 9, 1902.]

THE FLOOD'S AWFUL WORK.

MILLIONS OF DOLLARS' WORTH OF PROPERTY DESTROYED.— HOUSES AND BRIDGES GONE.

Barns Swept Away and Many Crops are Ruined. — Genesee Valley One Vast Lake — Biggest Flood Since 1865 *— Devastation is Spread Broadcast Throughout Western New York — The Water Four Inches Higher Than During the High Water of Last Spring — Flats Flooded From One End to the Other.*

Never in the history of the Genesee valley has there been such widespread devastation by flood, as there has been by the flood that is now raging. The nearest approach to it was the flood of June 1, 1889, when the valley was flooded from one end to the other, the crops ruined and waste and devastation was to be seen on every hand. This flood, however comes over a month later than the big flood of 1889, and for that reason will cause a much greater loss of property, as the crops are further advanced, and when the water recedes it will then be too late to replant and secure a crop for the present season. The present flood is a

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record breaker so far as midsummer floods in the Genesee valley are concerned, and the water was even higher by four inches than it was during the extremely high water during the freshet last spring. For a week or more prior to Saturday last this section of the country had been visited with frequent heavy showers, the ground was thoroughly saturated so that it would drink in no more water, the streams were running full, and it only needed the terrific downpour of water which followed to turn the Genesee valley from one end to the other into a seething, boiling river, which carried death and destruction before it. The terrific electric storm which visited this section of the country Saturday night last probably never was equaled in the memory of any of the inhabitants of the present generation. The water simply fell in torrents for several hours, and not only was it true of this section, but it seemed to be general throughout Western New York. Sunday morning found every tributary emptying into the Genesee with banks overflowing, and the river itself a raging torrent. The water rose rapidly and within a short time it covered the flats from one side to the other, and from Allegany county to Rochester. It continued to rise Sunday night, and Monday morning it stood four inches above the high water mark of the large flood of last spring. Trees, hay, fences, lumber and wreckage of all kinds have been going down the stream, and occasionally a dead horse, sow or sheep is seen to go past.

At the present time it is impossible to estimate the amount of damage that the flood has caused to the people of Geneseo and vicinity. Many of our citizens rent from five to fifty acres of land on the flats which they put into corn, peas, beans, etc., and many others have fields of hay, some of which was cut and ready to be stacked, and this, of course, will be a total loss. It certainly is a discouraging outlook to those who have crops on the flats, and it falls heaviest on those who can least afford to lose. It is estimated that at least 2,500 acres of crops in this section alone will be ruined. The heaviest individual loser in Geneseo will be T. L. Hall, manager of the Winters & Prophet canning factory, located here. Mr. Hall has hundreds of acres of peas

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and corn and it is thought that the crop will be practically ruined. His damage will amount to thousands of dollars. This will also throw out of employment a large number of hands which were employed at the canning factory.

Among those in this village who will be losers are the following: T. L. Hall, 125 acres peas, 200 acres corn; Frank Hagan, 50 acres corn and peas, 10 acres oats; Joseph Dwyer, 4 acres corn; John Collins, 5 acres corn and oats; James Callahan, 5 acres corn; Michael Donovan, 5 acres corn; Samuel Finley, 20 acres corn; S. S. Ewell, 2 acres beans; Minard Averille, 10 acres corn; Charles Werner, 5 acres corn, 2 acres clover; Myron Clark, 5 acres corn; L. Chapman, 3 acres corn; George Rice, 22 acres corn; F. Nixon, 2 acres potatoes; W. J. McCaughey, 10 acres grass; James Haley, 10 acres grass; Moffat & Lang, 26 acres grass; Neff & Neff, 16 acres grass; F. Hollowell, 2 acres grass; D. Donohue, 8 acres grass; Henry Colvin, 3 acres grass; M. Averille, 2 acres grass; W. J. McCaughey, 14 acres oats; Joseph Dwyer, 12 acres oats and peas; Charles Marsh, 2 acres corn. In addition to these, Mrs. Porter Chandler will lose about 150 acres grass; H. B. Dodge, of Moscow, 10 acres corn; Wm. Mann, of Wadsworth, 20 acres grass; Kiehl & Fitzgerald, Piffard, 4 acres grass; Wm. Moore, Piffard, 8 acres grass; John Brown, Piffard, 67 acres corn and peas, and J. W. Wadsworth, of this village, 8 acres of hay which had already been cut and bunched up; Willis Willard, 30 acres peas; James S. Wadsworth, loss about $2,500, hay, beans, etc.; J. W. Wadsworth, about 100 acres hay.

But this section does not suffer the loss alone. As we have before stated the storm seemed to be general, and there is widespread ruin in all sections of the country. To the south of us the storm seemed to be at its very worst. Sunday morning found the village of Pike floating around in four feet of water, and the damage to that place is estimated at $500,000. Much damage was also done in Hume, and the papers report the village of Wiscoy as practically wiped off the face of the earth.

At Arcade the flood carried six houses down the stream, and Miss Minnie Loper, a young lady who keeps a bakery in that place was drowned in her own house, and her body found lodged

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in a willow tree a mile below the village. At Batavia the Tonawanda creek rose fifteen feet, surrounding the jail, and the prisoners had to be taken up stairs to places of safety.

Two-thirds of the village of Hornellsville was under water Sunday, and not a train could be moved out of the city.

At Fillmore, in the upper Genesee valley, the water stood five feet deep on the main street of the village, and the residences and business places were filled, and the contents ruined. Two houses were carried away with all their contents, besides a number of barns, shops and other buildings. Many of the inhabitants of the place were forced to flee to higher ground in their night clothes while others were rescued in boats. Large sections of the Pennsylvania railroad have been washed out, in many instances the embankment being carried away. At Rosses the bridges and 900 feet of the track were swept away, and it is reported that thirteen bridges in the town of Hume were swept away.

At Warsaw it is estimated that the damage will amount to $100,000. The Oatka creek became a raging torrent, cutting a channel through the principal streets, wrecking houses and barns and sweeping everything before it. The loss to the Shantz Button Company is said to be upwards of $10,000. Cellars were submerged, gardens destroyed and the electric light plant put out of business by the high water. The damage in that town will amount to thousands of dollars.

The flats of Mt. Morris were entirely submerged by water. Whole farms in that town are planted to corn, peas and beans and the crop will be ruined. The loss there will fall heaviest on the Winters & Prophet Company, who rent much of the land in that section. The flats from Mt. Morris to Dansville were entirely under water, and the crops in that section will be ruined. The Dansville & Mt. Morris railroad was unable to run any trains, as the large trestle over the Kishaqua creek was washed away.

Many of the railroads all over the country are completely tied up, and it will be a number of days before many of them will be able to run again. The Erie train was unable to get to Buffalo Monday, owing to a big washout at Attica.

The losses do not fall entirely upon those who own property on the low lands. The farmers all over western New York will be heavy losers. In many places on the uplands the crops were submerged, while thousands of acres of hay were ruined by the wet weather. It is impossible to anywhere near estimate the damage that has been wrought in western New York by the severe storms of the past ten days, but it will amount to well up into the millions. Floods are also reported from Indiana, Illinois, Missouri and other western states, with immense damage in all sections.

FLOOD NOTES, JULY 16, 1902.

It was a hard blow to a whole lot of people.

No one wants to see another flood of that kind.

The flats are said to be a hard looking sight.

Thousands of dollars' worth of fences have been washed away.

John W. Slaight, of Kysorville, estimates his loss at about $1,500.

Winters & Prophet estimate their loss at about $15,000 in this village.

James Shefflin had 150 acres of crops under water and they are ruined.

The wheat on the flats is not as badly damaged as the rest of the crops.

It is about an even toss-up as to which does the most damage, fire or water.

Many old timers say it was the largest flood that ever visited the Genesee valley.

Reports from other villages show that the damage has not been overestimated.

Mr. Brisbane, the tenant on Mr. Cone's Sonyea farm, will suffer a loss of about $2,000.

William Hopkins, of Fillmore, was drowned in his house before he could be rescued.

The effect of the wet weather in some places has been to turn the corn a very dark red.

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There are many persons who will feel the effects of the July flood of 1902 for years to come.

Bates Wooster, of Cuylerville, had about 150 acres of grain and grass, which will be a total loss.

All of the young pheasants and quail on the flats have been killed, as well as many of the older birds.

L. J. Prettyjohn, of West Sparta, was a heavy loser. He had forty-eight acres of onions and vegetables under water.

So far it has been ascertained that four lives have been lost in western New York on account of the recent flood.

George White estimates his loss at about $8,000. Through fires, floods, etc., Mr. White certainly plays in hard luck.

It is estimated that the damage in the Genesee valley alone will amount to between two and three millions of dollars.

The storage dam would have been but little use in the recent flood, as the reservoir would have been full from the spring freshets.

There are large quantities of dead earth worms all over the flats, and the stench in some places from this source is something terrible.

Many of the people on the flats have been obliged to move out on account of the terrible stench from decaying vegetation and animal matter.

It is estimated that the loss to Winters & Prophet, of Mt. Morris, will be $35,000, and to John White $20,000. That is hitting the target pretty hard.

The canning factories in both this village and Mt. Morris have closed down, and a large number of hands have been thrown out of employment.

Many farmers lost their entire hay crop. Clover hay will not stand much rain after it is cut, and in many instances the hay is not worth drawing in.

Fred C. Simerson, of Mt. Morris, is one of the heavy losers. He has about 140 acres of grass, corn, peas and beans, and the damage will amount to about $2,500.

Conesus lake rose nearly two feet, and many of the docks built by the cottagers have been put out of commission. A part of the dock at Long Point was under water.

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It was reported that during the height of the freshet a horse and buckboard, with a trunk lashed to the buckboard, was seen to go over Portage falls, but the report has not been confirmed.

After the water went down the stench on the flats was something awful from decaying vegetation, dead animals, birds, etc., and it will be remarkable if more or less fever does not follow as a result.

We have heard of one or two instances where the owners of farms have told their tenants there will be no rent to pay this year, and it must have the effect of letting a little sunlight upon a dark situation.

John Caten, of Leicester, lost his entire crops of 150 acres. He had nothing left to feed his stock and he sent his horses to one of his neighbors to be fed, while he has gone to work by the day for a farmer on the upland.

Mr. and Mrs. Arthur Cummings have moved from their farm on the Cuylerville road to this village and will remain here until things sweeten up a little on the flats. Mr. Cummings' crops will be almost a total loss.

Rev. Iry L. Hicks, who prophesied the exact dates of the recent storm, says that another storm is due the 22d and will last until the 24th. It will not be accompanied by so much rain, but will be something of the cyclone order.

The damage at South Lima from the heavy rains is greater than was at first supposed. Much of the onion and celery crop was entirely under water, and it is estimated that the damage will not fall short of $150,000. It is a serious blow to this thriving community.

Mr. Perkins, who has resided on the Cuylerville road for the past seventy or eighty years, just west of what is known as the Cuylerville bridge, says he never saw the water as high in the Genesee valley before, and there is little question but what the flood was a record breaker.

The Dansville & Mt. Morris railroad was hit hard. The long trestle at Kishaqua creek was washed away and the officials went at once to work in hopes of getting the trains running, when the

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second storm washed away the tools. The road will be put in shape as soon as possible.

Congressman Wadsworth and his son, James W. Wadsworth, Jr., estimate their loss at about $45,000. They had about 2,000 head of cattle grazing on flat land, and although none of the cattle were lost, it will be almost impossible to find pasturage for this number of cattle outside of the flats.

Willis Willard had 38 acres of peas on the flats, and 13 acres had been harvested before the flood and brought $40 per acre. The remaining 25 acres were good for at least $10 more per acre than the early crop, and that was $1,250 swallowed up in short order, in addition to a lot of hay that he lost.

Congressman Wadsworth had fifty-seven head of cattle on the flats above Mt. Morris. They swam around in the water for hours and finally made for a barn, the door of which was open, and they managed to get inside where they stood in water two or three hours before being rescued. Not one head was lost.

T. L. Hall was telling a lot of men one evening about going across the flats in a row-boat when the water was receding. He said that he saw dead woodchucks and birds floating around, and up in the crotch of a tree sat a skunk. W. E. Booth, who happened to be one of the listeners, remarked that the skunk saved a (s)cent anyway.

There was probably no village in western New York which suffered more on account of the flood than the village of Angelica. A large number of houses and barns were carried away and demolished, others were left standing in the middle of the street, live stock was drowned, and the people were obliged to flee for their lives in the middle of the night. On some of the streets holes were washed out fifteen feet deep, and when the water receded it left the houses and stores filled with slimy mud five or six inches deep, which had to be shoveled out. Many persons had narrow escapes, and the majority of them were obliged to remain in the upper stories of their houses until morning, and in several instances they were even forced to the roof. Horses, cattle, pigs and poultry were carried away.

THE FLOOD QUESTION.

The civic committee on floods, appointed by Mayor Rodenbeck of Rochester, to co-operate with the State Flood Commission, held a meeting at Rochester last week Wednesday and presented a lengthy report of their investigations. From a reading of the report we take it that the gentlemen on the committee deem it the duty of the state to construct a dam or dams at certain places on the river which would hold back the waters in the upper stream and thus prevent the destructive floods.

Men who have studied the matter believe that the construction of a storage dam is the only way to obviate the floods, but here the question arises, is it proper that the state should be called upon to bear the entire expense? Would it not be a difficult matter to get such a law through the legislature? On the contrary would it not be an easy matter to get a law through, providing the city of Rochester, land owners and other persons in interest would agree to pay a certain portion of the cost of such dam.

We think we are safe in saying that the property destroyed from Portage to Rochester by the overflow of the river during the past six months would be fully equal to one-half the cost of a storage dam at the high banks west of this village. Of course we would all like to see the state build the dam, but it is not at all probable that it will ever do it unless a part of the expense at least is borne by those most vitally interested.

The report referred to above closes as follows:

"The most obvious and only effective remedy, and the one which has been discussed particularly during the past twelve years, is the construction by the state of a storage reservoir at Portage or Mt. Morris, or at both places, which would enable the state to impound the waters of the Genesee river during flood periods and thus protect the life and property of its citizens along the course of the river.

"By the construction of such a dam or dams, the state would be fulfilling not only its obligation to protect the lives and property of its citizens dwelling along the river, but also would be discharging an obligation which it owes for interference with

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water rights. The state is now taking large quantities of water from the Genesee river for the operation of its canal. This is an interference with the uninterrupted flow of the river and an impairment of the water rights of property owners below the points where the water is abstracted. Enlargements of the canal are contemplated and there are in progress improvements which will require a still larger supply of water from the Genesee river. This additional supply cannot be taken without interfering with valuable water rights. The recognition by the state of the unjust interference with these rights and the construction of a reservoir to compensate property owners for damage would be nothing new, for the state has already acknowledged this principle by creating reservoirs from which the canal could by no possibility receive water for the express purpose of indemnifying mill owners for water diverted into the canal."

Exhibit No. 6.

[*The Union and Advertiser, Monday, March* 3, 1902.]

RIVER HIGHER THAN AT ANY TIME SINCE '65

STILL RISING AND THERE IS NO INDICATION OF DIMINUTION OF THE FLOOD.

Exchange Street, Part of Court Street and a Long Stretch of Front Street Under Water. — Serious Damage Done to Stocks of Goods in Cellars on Main Street. — Fire Engines Try to Pump Out Business Houses.

The flood in the river at this writing, 1.15 o'clock, threatens to increase largely. The water has been rising steadily all morning and the streets that were flooded last night are being buried deeper and deeper under water. The flood is now greater than at any time since 1865, when "the" flood occurred and the water was three feet deep in Reynolds arcade.

Front street, from Market to Andrews and below, is under three feet of water. The flood bubbles up through cracks in the sidewalks and flows unobstructed through the stores on the river

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side into the street. Exchange street, from Glasgow street to Spring street, is under water and all cellars are full.

City Engineer Fischer, this morning, gave out a table showing the rise of the river. The permanent elevation of the crest of the Court street dam is 241.91 feet. Measurements are made from that elevation. The table follows:

Feb.	27.	8.15 a. m.	242.35 ft.
	28.	7.45 a. m.	242.90 ft.
March	1.	7.40 a. m.	245.90 ft.
		10.00 a. m.	245.75 ft.
		12.10 p. m.	245.85 ft.
		3.00 p. m.	245.90 ft.
		5.00 p. m.	246.30 ft.
		6.00 p. m.	246.80 ft.
		9.45 p. m.	246.85 ft.
	2.	7.50 a. m.	247.45 ft.
		12.00 m.	247.85 ft.
		3.00 p. m.	248.15 ft.
		5.00 p. m.	248.45 ft.
		9.20 p. m.	248.35 ft.
		11.30 p. m.	249.18 ft.
	3.	1.30 a. m.	249.30 ft.
		5.30 a. m.	249.38 ft.
		7.45 a. m.	*249.45 ft.
		10.00 a. m.	249.30 ft.
		11.00 a. m.	249.37 ft.
		12.00 m.	249.40 ft.

A report gained circulation this morning to the effect that "the dam at Mt. Morris had broken and that the city was endangered by the flood that the break had let loose." Anxious inquirers began telephoning to newspaper offices for particulars of the break. There was nothing whatever to the story. There has not been a dam at Mt. Morris in three years. A small dam at Cummingsville, near Dansville, in Canaseraga creek, did break, however, early in the morning. It had little or no effect on the Gen-

* Inaccurate.

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esee because just below the mouth of the creek the flats of the river are very wide. All below Dansville was like a lake.

Thousands of people assembled on the aqueduct, Court street bridge, at the Erie depot and on Front, Exchange and other streets this morning to view the flood and its effects in this city. The fact that many of the manufacturing plants in the flooded districts had to close down because they had no power gave many an opportunity to go about at their leisure and see the damage done. The aqueduct was black with people as early as 8 o'clock this morning and at noon the crowd had reached such proportions that people were almost pushing each other into the canal. On Court street bridge at least 2,000 sightseers were viewing the angry swirl of the river and all along the front of the Erie depot the bank was lined with spectators. Policemen were at all points to prevent the onlookers from going into dangerous places. A magnificent view of the river can be obtained from Court street bridge and the same is true of Clarissa street bridge, which was also filled with spectators this morning. In Front street women, children and men collected to see the water flowing through the center of the street and watch the attempts of merchants to rescue their goods from the flood. From Main street to Corinthian street the walks were filled with people all the morning and Mill street and Central avenue at the foot of Front street were gathering points for hundreds. The flood in Exchange street attracted many, while the flooded streets in the southern part of the city were viewed by countless sightseers. It was such a sight as probably Rochester will never see again and all who could get to any vantage point to watch the river did so. The river bridges north of Main street, at Andrews street, Platt street, Vincent street and even Driving Park avenue, held crowds and the people kept coming and going from these places all the morning. At the Four Corners and in the center of the city the streets were filled with people. Each building where there was a steamer at work pumping out the cellars attracted a crowd, while the curious also gathered about the stores where goods were being taken from the cellars. The crowds were much larger than in 1896, when the river last got on the rampage.

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FRONT STREET WORST.

Two Feet of Water in the Center of the Street and All Cellars Flooded.

Front street has suffered worst to-day from the big flood. From the foot of Market street to below Andrews street there is two feet of water in the center of the street and business along the entire street is suspended. Water began coming into the Kenney & Cullen cafe at the northeast corner of Main and Front street, late yesterday afternoon and this morning there was four feet of water flowing through the barroom and dining room. The bar, bottles, tables, chairs and other effects were floating about in the water promiscuously and a curious crowd stood outside the open door looking in. The attaches of the place deserted last night and got out none too soon. The cafe is in the basement and this morning the water was flowing through the place with terrific force.

The cellar of the Flour City Glove store adjoining the cafe had several inches of water in it at 8 o'clock this morning and C. W. Atkinson on the same side of the street reported two feet of water in his cellar. The second-hand stores to the north on the same side had from three to four feet of water in the cellars at 8 o'clock, but the owners had all moved their goods upstairs and there was no damage. Beginning at 32 Front street on the same side of the thoroughfare the merchants were not so fortunate as those south of them. From here to the Front street building the water was coming up through the sidewalk, and all the cellars were filled, and the water was running over the store floors. The damage in these stores cannot be estimated at present. Many of the store owners had moved their goods from the cellar, but they were wet just as effectually on the first floor as if they had been below. City Assessor Frank Fritzsche, who sells hides at 62 Front street, said that he had a large quantity of hides in the cellar and some of his merchandise on the first floor was damaged. The John Price Company, at No. 64, also suffered considerable damage.

But for the fact that the firemen in the Front street building built a dam along the back of the building, the Hayes truck

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company, chemical and the poor department people, who helped in the work, would have been obliged to move out this morning. The firemen and poor office employees worked all night and erected a dam across the back doorways two feet above the floor level. This will keep them comparatively dry this morning, although the river was a foot above the level of the floors. The cellar had eight feet of water at 9 o'clock this morning.

From the Front street building to below Andrews street the center of the roadway looks like a river. Two feet of water is swirliug through the street, and the stores along both sides of the street are completely flooded out. There is from two to three feet of water over the first floors of the stores, and nothing but teams have passed through this portion of the street to-day. The damage is enormous, but cannot be estimated at present because the store owners cannot reach their places of business. The York house basement, at the corner of Corinthian and Front streets, is filled, and several cellars on Corinthian street are flooded. At the corner of Andrews and Front streets the Fahy market is flooded, and the water extends some distance west into Andrews street.

Some of the business men on the west side of Front street south of Market street suffered. At the East market, at the corner of Corinthian street, there was two feet of water in the cellar this morning, and all other merchants on the west side of the street to the north of the East market suffered. Most of them worked all night to get the goods out of their cellars, but could not remove all of the merchandise.

WATER STREET FLOODED.

Cellars Filled and Power Crippled, So Business is Suspended.—Some Damage to Stock.

The cellars on both North and South Water streets are flooded from four to six feet deep to-day and the fires have been put out under all boilers by the water, so business in many plants is suspended. In some stores along the street considerable damage was done to stock by the water. Fee Bros., at 21 North Water

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street, reported three feet of water in their cellar at 9 o'clock this morning, but there was no damage to stock. At the Brewster, Gordon & Company warehouse, at 39 to 47 North Water street, the cellar was flooded with three feet of water early this morning and the damage done to stock cannot be estimated. The John Siddons Company, of 61 North Water street has three feet of water in the cellar, with some damage to stock.

USELESS FIRE ENGINES.

Unable to Pump Water, but Strong on Noise and Smoke and General Disturbance.

The condition of the fire apparatus in this city, if one is to judge by the engine that tried to pump water from the cellar of the Wilder buiiding for three or four hours this morning, is such that, were the city to depend upon the machinery of the department in case of fire, it would be utterly without a weapon against the flames.

The engine used up a great amount of expensive coal, half a dozen firemen chased up and down the street, the air was filled with smoke and steam and cinders, battalion chiefs drove up and down in their nice little red wagons, each accompanied by a driver, small boys shouted and horses shied, but the water in the cellar continued to gain on the floor and soon the fires under the boilers were extinguished and the tenants on the top floors began to use language.

It was a sad spectacle. The engine, bright and shiny, belched forth smoke and sparks, the engineer looked wise, the other men in uniform who stood around bossing the job tried to look wise and yet not a drop of water came out of the cellar through the aid of the machine. The Wilder's own pump brought up a great deal, but the city engine was good only for show. The number of the handsome but worthless piece of machinery is six. Six ought to be retired at once.

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RESCUED IN BOATS.

Mt. Hope Avenue Residents Had Exciting Experience in Early Morning.

To the residents of that section of Mt. Hope avenue lying between Alexander and Gregory streets the early hours of this morning were fraught with the greatest excitement. When the feeder bank gave way a torrent of muddy water rushed down the state waterway and overflowed into the yards on the west side of Mt. Hope avenue. It rushed into the street, flooding yards and cellars, and at Averill avenue, in Mt. Hope avenue, it attained a depth of fully four feet. Notice of the oncoming flood was given to the residents of the houses, but so rapid was the rush of waters that few of the residents had an opportunity to leave their homes.

Others affected to believe that the flood was but a temporary inconvenience and refused to take advantage of the opportunity afforded to leave their homes and later had to be carried away in boats. In some cases boats had to go through four feet of water to reach residences from which the occupants were anxious to escape.

In the hour between 6 and 7 o'clock there were a dozen or more boats plying in Mt. Hope avenue, and in some cases where the occupants of houses refused to move out, grocers' and butchers' wagons brought supplies as near as possible, and the boats carried provisions to the houses.

Furniture was moved from the first floors of some of the houses to upper stories, and should the depth of water continue for any time there is bound to be considerable suffering, as all furnace fires have been extinguished, and access to the coal bins in the cellars of the flooded houses is impossible.

POLICEMAN'S MISHAP.

Overturned Canoe in Which He Was Riding.

Policeman Matthias was active in assisting in the work of notifying the people in Mt. Hope avenue, rushing into the water up to

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his waist and helping to load the boats which were speedily pressed into service. From 4 o'clock until 10 o'clock the boats plied between the houses and many people who earlier in the day had refused to leave their homes, decided to make trips to dry places in the impromptu ferries.

In the midst of the work of rescue there occurred one of the numerous incidents that provoked a laugh even from those persons whose homes were under water. Policeman Matthias and John Burns were in a canoe propelled by Mr. Burns. Matthias wished to sound the alarm on his police whistle and stood up to blow it. One piercing blast sounded and then a second one was suddenly interrupted. In standing up the policeman had overbalanced and he and his boatman were dumped into four feet of exceedingly cold and muddy water in the middle of Mt. Hope avenue to the great amusement of everybody but the two erstwhile occupants of the canoe. Both secured changes of clothing and returned to the work of rescue.

Cellars in Mt. Hope avenue, between the streets named, were filled to a depth of anywhere from four to seven feet, and back yards were transformed into lakes.

The water was increasing in depth in Mt. Hope avenue all morning and the streets running toward South avenue were also visited by the flood. Averill avenue, at noon, showed something over a foot of water near Mt. Hope avenue and six inches at Ashland street, half way to South avenue.

WHERE BREAK OCCURRED.

Feeder Bank Went Out for Distance of About Seventy Feet.

The break which caused the trouble in Mt. Hope avenue occurred in the bank of the feeder at a point about 200 yards south of the Erie railroad tracks. For a distance of about seventy feet the bank gave way and this gap was speedily widened by the rush of water, which swept everything before it.

Rushing down the feeder the torrent tore away a temporary dam that had been built by the Lehigh Valley Railroad Company and the water sweeping on in a wave some six feet high, spread

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to the country adjoining the feeder, covering it to a depth of from one to four feet. The ice in the bottom of the feeder was lifted and forced up on the banks or jammed against canal boats which were wintering in the basin and the drawbridges leading to the Lehigh Valley railroad yard.

With the dams caused by these jams the water backed up, filling cellars and yards and transforming the latter into miniature lakes. The canal was soon filled to a depth of several feet and by afternoon was almost at its normal summer level.

SULLIVAN'S FERRY.

National Casket Company's Employee Carried Other Employees.

Big white-haired William Sullivan, the driver for the National Casket Company, corner Exchange and Court streets, donned a pair of high rubber boots early this morning, and furnishing himself with a handcart, started out to serve as a ferry.

Other employees of the factory and neighboring establishments, unable to make their way through the stream which tore down Exchange street, were compelled to entrust themselves to "Sully" and his pushcart, and for some hours a crowd watched the big chap act as ferryman for such persons as did not possess a pair of boots.

AT SOUTH PARK.

Water Has Submerged Boat-House, Merry-Go-Round and Hundreds of Acres of Land.

South Park is getting the benefit of a great share of the water. Since yesterday morning it has risen several feet and the greater part of the park is under water. The boat houses are surrounded by anywhere from two to five and six feet of water, and some of the smaller structures are in danger of being floated down stream.

Both of the baseball diamonds are under three feet of water, and just north of the Elmwood avenue bridge the river is more than twice its normal width, having spread out to the roadway

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and at some points touching the embankment which carries the Pennsylvania railway's tracks.

The street car tracks are under water to a point some 200 feet north of Brooks avenue, and the railing on the retaining wall, which stands above the street about forty inches, is completely covered by the water.

The golf links are practically all submerged, and the bicycle track is filled with water to the top of the fence surrounding it.

At the Rochester Athletic Club's boat house, 200 yards south of Elmwood avenue bridge, the water is almost up to the sills of the first-story windows, but there is no fear entertained that the house will be carried out unless the water should rise several feet. The boat livery is surrounded by water and the public locker house at the bridge is surrounded by four feet of water.

Over on the east side of the river the top of the merry-go-round is just visible above the surrounding waters.

Roadways on the east side of the river are under several feet of water, and with the strong current that is running extensive repairs will be necessary after the flood subsides.

MILL STREET CELLARS.

Water Ran Through from Front Street and Flooded Them.

From Front street the water ran through into the cellars on the east side of Mill street. The cellar of the H. B. Graves warehouse, at 72 Mill street, was flooded with three feet of water at 8 o'clock. The employees worked all night getting out the goods, and the damage was trifling. There was also water in the cellar of the Blauw Drug Company at 60 Mill street. The Weaver, Palmer & Richmond warehouse cellar, at 41 Mill street, had several inches of water at 8 o'clock, but all goods had been safely removed to the first floor.

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EXCHANGE STREET FACTORIES.

Flood Causes Casket Works and Shoe Factory to Shut Down for the Day.

The National Casket Company's factory, at Court and Exchange streets, and the Armstrong shoe factory, one of the largest concerns of the kind in the city and which is situated on the west side of Exchange street, almost directly opposite the casket factory, were obliged to shut down because of the flood, the water having reached the basements of the buildings, preventing the engines from running. A pump was in operation at the shoe factory and water was being drawn out rapidly during the day.

At the casket works the water broke in through the sidewalk at 11 o'clock, making a large hole and flooding the cellar in spite of the energetic efforts of the employees to stop the progress of the water. The damage in both of these factories will be considerable. Of course none of the stock will be interfered with.

The basement of the police station was not flooded. Water began to pour in through the cable conduit last night at 11 o'clock, but the engineers were sent for and the conduit was calked, stopping the inflow of water. The water that had flowed in soon disappeared and to-day the cellar is dry and the boilers are not interfered with.

CABLE CONDUITS FLOODED.

Telephone and Light Service Somewhat Interfered With.

Telephone and electric light service in the center of the city is considerably hampered by the flooding of the underground cable conduits. The rapid rush of water through some of the conduits will no doubt seriously damage not only the cables, but the conduits as well.

All of the conduits have surface openings, the coverings of which are perforated, so that gases can escape and explosions be prevented, the water in the streets, and especially on Exchange street, found its way into the conduits and rushed through them in torrents, disturbing the cables and damaging the walls of the conduits.

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FROM JAIL TO POLICE STATION.

Prisoners Had to be Carried Back and Forth in Patrol Wagon.

The patrol wagon had to be called into service this morning to carry the prisoners from the jail to the police station and from the station to the jail. The water being a foot or more deep at this point, it was out of the question to walk the prisoners, as is customary.

The wagon was nearly filled on the trip from the jail to the station, and the prisoners seemed to enjoy the ride through the water. On the trip back there were not so many prisoners, but what they lacked in numbers they seemed to make up in enthusiasm, for as they left the station and the horses and wagon plunged into the rapidly rushing water they gave a mighty cheer.

FEEDER HIGHER THAN RIVER.

Flowing Over the Lehigh Tracks Into the River.

The rush of water from the river through the break into the feeder raised the level of the feeder until it was fully a foot higher than the river and the water spread over the Lehigh Valley tracks from a point some distance above the Clarissa street bridge to a point almost down to the coal trestle.

There are no trains running out from Rochester over the Lehigh Valley road, owing to the flooded tracks, and railroad ties seen floating in the river above Clarissa street bridge on the east side of the river would indicate that the roadbeds of the railroads are being undermined.

The feeder also emptied into the yards in Mt. Hope avenue all during the day. Up near Mt. Hope the river road is submerged to a depth of several feet, and the water has spread out over the adjoining lowlands to a depth of several feet.

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Figure 1. Photograph of Ruins of Cathedral of Saint Paul, c. 1865.

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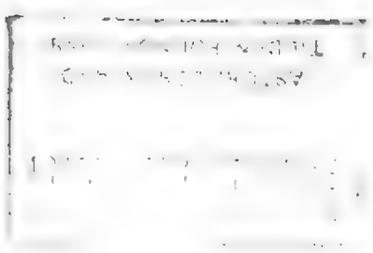
Fig. 1. Ruins of the Church of Saint Nicholas in Myra, Turkey, after the earthquake of February 2008. Photo: Ahmet Ercan.



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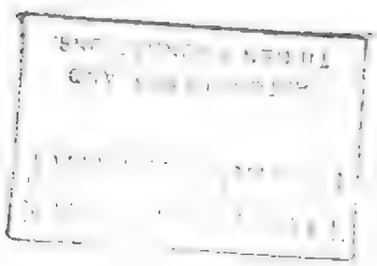
Fourteen months in the Yukon River, on April 15th, the Yukon Central Bridge was thrown down by 47 feet ft. 1903.



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Fotografia de Eduardo Chillida no seu estúdio em Hernani, Gipuzkoa, 1966.

Train standing on new bank of the Swastika River south of Temiskaming. Bertie S., 1907.

PLYMOUTH AVENUE SUBMERGED.

Four Feet of Water Surrounds Houses at Upper End.

Residents of the houses on the west side of Plymouth avenue, south of Brooks avenue, are hemmed in by about four feet of water, and their only communication with the world is by means of boats. Each of the houses has a boat and the occupants are able to get out, but cellars are filled and the water flows over the lower floors.

Outbuildings were being anchored with cables when a reporter for *The Union* visited the scene this morning. The water in Plymouth avenue extends to within a short distance of the Pennsylvania railway tracks.

OLD VALLEY CANAL.

Water Fills the Bed From Vacuum Oil Works to Atkinson Street.

Water fills the bed of the old Genesee Valley canal from a point south of the Vacuum Oil works to a few feet past Atkinson street. It enters the canal a few feet north of where the bed is filled in to allow the crossing of the Plymouth avenue and the Rochester division of the Pennsylvania, formerly known as the Western New York & Pennsylvania railroad. Here it covers the tracks of a siding to the Vacuum Oil works, but does not cover the main track until the oil works is reached. It is over the wheels of freight cars standing on the rails from this point to Atkinson street.

The road is nearly level and is built on the bed of the old canal. The roadbed does not rise until just north of Atkinson street, but it is sufficient to keep the rails out of water from there on.

ON THE RAILROADS.

Flood Interferes With Traffic on All Lines Entering Rochester.

The flood caused by the Genesee river overflowing has seriously interfered with business on the Lehigh Valley railroad and has caused traffic on that line to be suspended. The tracks of that

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line entering the southern section of the city are covered with water four or five feet deep, making it impossible for trains to pass through. A suburban train reached here at 10.30 o'clock and stopped at Elmwood avenue. No trains reached Rochester this morning, and no attempts were made to send trains away from the city.

Traffic on the Erie railroad was also suspended this morning, as the tracks of this road were, like those on the Lehigh Valley, covered with several feet of water. Tracks on various parts of the Rochester division were all covered with water this morning.

On the Central road only two trains arrived here this morning from New York city. Train 19, due here at 1.30 a. m., pulled into the Central avenue station at 9.30 o'clock this morning. Train 35, scheduled to reach here at 6 a. m., arrived at noon. West Shore train No. 3 reached Rochester at 8.30 o'clock this morning, being five hours late. The tracks east of Syracuse are covered with water and interfered with traffic. Trains from the west were on time to-day, or only slightly delayed. The Southwestern Limited was thirty minutes late. On the Auburn road and Falls road branches trains were reported to be on time to-day.

On the Buffalo, Rochester & Pittsburg road trains were run on the Central tracks to Le Roy and then over the "Peanut branch" to Le Roy, and then the road's own tracks were taken.

MR. McCLINTOCK ACTS.

Sewer Openings Stopped up So Sewers Cannot Fill with Water and Back Into Cellars.

Commissioner McClintock had the openings to the Exchange street sewer south of the canal stopped up last night, so the water from the river could not flood them and cause them to back up into the cellars of firms along the street. This move has been criticized by some, but those who are benefited by it are very grateful to the commissioner for his prompt action.

The same thing was done in the big flood of 1896 by the executive board, but it was not done until the sewer had filled, and did

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no good. The city engineer says the cellars of the buildings at the Four Corners which are flooded to-day have taken in water from the Front street sewer, which could not be stopped up effectively.

PEST HOUSE SURROUNDED.

Six Patients Are Confined in the Institution at Present Time.

Mt. Hope Hospital, familiarly known as the pest house, is in the center of a small lake to-day, water surrounding it on all sides and the current is lashing against the front door of the institution.

Health Officer Goler was a visitor at the place early this morning. He found the six patients confined there, a woman and five children, not at all apprehensive of any danger, the children especially being inclined to treat the whole affair as a huge joke.

All necessary precautions to insure the safety and comfort of the inmates are being taken and a watch will be kept so that they may be removed should there be any danger.

DROVE OUT MUSKRATS.

Flood Furnishes Harvest for Amateur Huntsmen Along River.

The high water drove out numerous colonies of muskrats along the banks of the river, and yesterday and to-day amateur huntsmen were out in force, trying to pot the animals.

Along the east bank of the river near the rapids is a clump of willows, and in here a number of the animals sought refuge. Two young men with guns discovered the rats and in the course of an hour managed to kill some fifteen or twenty, securing the bodies with a boat.

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RECOVERING FROM EFFECTS OF FLOOD.

CITY'S STREETS FREE FROM WATER, BUT COATED WITH ICE.

Railroads Getting in Shape to Resume Traffic. — Erie Road Open This Morning. — Cellars Have Been Freed from Water, and Affairs Will Soon Resume Normal Condition.

The permanent elevation of the crest of Court street dam is 241.91 feet. Measurements made at the crest of the dam by the city engineer's office force from yesterday afternoon at 4 o'clock up to noon to-day, when the measurements ceased, are as follows:

4.00 p. m.	249.55 ft.
5.00 p. m.	249.50 ft.
6.00 p. m.	249.50 ft.
7.00 p. m.	249.45 ft.
8.00 p. m.	249.45 ft.
9.00 p. m.	249.40 ft.
10.00 p. m.	249.35 ft.
11.00 p. m.	249.17 ft.
12.00 p. m.	249.10 ft.
1.00 a. m.	249.05 ft.
2.00 a. m.	248.90 ft.
3.00 a. m.	248.85 ft.
4.00 a. m.	248.75 ft.
5.00 a. m.	248.65 ft.
6.00 a. m.	248.50 ft.
7.00 a. m.	248.40 ft.
8.00 a. m.	248.35 ft.
9.00 a. m.	248.30 ft.
12.00 m.	248.30 ft.

To-day Rochester is recovering from the effects of the flood, and within twenty-four hours things will have been restored, in a great measure, to their normal condition. Shortly after 4 o'clock yesterday afternoon the river began to fall, and since that time it has fallen slowly but surely, until at noon to-day it was something more than a foot below the top of the opening in the aqueduct arches.

Crowds still gathered at the various points of vantage to watch the water, but the gatherings numbered fewer persons than yesterday. The streets which were visited by the waters yesterday were centers of attraction for the curious, and much interest was manifested in the operations of the men who were devoting their energies to repairing damage caused by the flood.

Railroad traffic is once more getting into such shape that people are not afraid to venture out lest they be stalled, and by to-morrow morning, should present conditions continue, trains are expected to be on schedule time or nearly so.

In the Streets.

Probably most interest to-day centered in the streets which were visited by the rush of waters yesterday. While the water had receded in each of the streets, evidences of its presence were everywhere. Sheets of ice covered the roadways and sidewalks, while stained walls, broken down fences, sidewalks torn from their usual positions and other similar reversals of normal conditions bore witness to the effect of the rush of waters.

In Front street, where the water was flowing through the center of the street yesterday to a depth of two or three feet, there was no water this morning, but in that section of the thoroughfare where the water had been deepest there was ice anywhere from an inch to six inches in thickness, while at the corner of Andrews street heavy stone flagging had been torn from its position and gaping holes in the walk were guarded by policemen and signs called attention to the fact that the way was dangerous.

The stores along Front street were swept out to-day and as speedily as possible evidences of the flood's visit will be obliterated. Merchants have not as yet been able to figure up their loss, but in many instances it will assume figures that will seriously cripple the owners of the places.

Mt. Hope avenue shows more traces of the flood, possibly, than any other street. The roadway from Alexander street to Hickory street, is coated with ice, fences and sidewalks have been torn from their usual places and debris of various sorts shows where the waters rushed in yesterday morning.

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Cellars on this thoroughfare are practically free from water to-day, but there is every evidence of their presence. Back-yards are skating ponds, ice covering water anywhere from six inches to three feet deep. Fences bordering the bank of the feeder have for the most part been washed away or at least flattened, and rear doorsteps and sidewalks ornament other sections of the yards.

Exchange street presents an appearance little different from that of Mt. Hope avenue. Ice is everywhere on the sidewalks and roadway between Glasgow street and Spring street. Sidewalks in front of some of the establishments have been cleared, while on others men were busy all morning removing the ice and the dams which had been built to prevent the entrance of the water into cellars.

Pumping Almost Finished.

This morning there was but one steam fire engine in commission to pump out cellars, that being stationed at the Rochester Savings Bank building, where it had been at work since early last evening. Other engines worked until early this morning at the Powers Hotel, and Powers block, while the Wilder building cellar was cleared with the aid of a big steam pump operated by a traction engine.

Later the steamers may be called into requisition to assist in emptying other cellars, but just now this seems unlikely. Late last night the water had fallen enough to enable some of the sewers to fulfill their duty, and this was even more effective than the engines in clearing cellars of dirty water. Some cellars still have some inches of overflow from sewers, but they will be free before night and then efforts will be made to remove all traces of the flood.

Railways Getting in Shape.

The railroads are rapidly recovering from the effects of the high water. The Erie railway this morning had a train in from the south and also sent one out. By late this afternoon it is hoped to resume the schedule. The train due here at 8.30 o'clock this morning reached the Court street station at 9 o'clock, and an hour later a train was sent out for Elmira.

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Some of the intending passengers on the 10 o'clock train went up to the old Foley lumber yard south of Clarissa street bridge, and the train stopped there for them to board it. Between the station and the bridge the train ran through water varying from six to twenty inches in depth.

There were no wheels moving on the Lehigh Valley road this morning, but active steps were being taken looking to an early resumption of traffic. A gang of some seventy men was at work on the track running along the feeder, removing the ice that had been swept up on it yesterday when the water broke through above the pest house. There is a train of a dozen cars loaded with dirt and gravel on the track a short distance south of Clarissa street bridge, which will be used to fill in as soon as the water in the feeder has dropped a trifle lower.

Just south of the bridge a dam has been built by the state employees, and this diverts the water over the railway's tracks, but at noon to-day it was lowering to a sufficient degree to permit of men to work in it, and they cut away part of the embankment between the river and the feeder that the water from the feeder might more readily find its way back into the river, thus making it possible to get trains through.

Slush Ice in the River.

The river this morning bore on its surface quantities of slush ice, most of which was the result of last night's fall in temperature. From time to time there was a cake of heavy ice to be seen, but not enough to cause any worriment.

There was no driftwood to be seen and indications are that the course of the river is remarkably free from such things. At the dam, above Court street, the water still ran over the wall at the head of the Water street race, but in no such volume as yesterday, and before night there will be little or no water entering the race at that point.

The water had not entirely receded from the Erie railway tracks, although it was much lower than yesterday.

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Cleaning the Round House.

Water still filled the pit in the Erie round house this forenoon, but there was a force of men at work pumping it out and clearing away the ice which had formed over the tracks and flooring, and by nighttime all traces of the flood, except the water in the pit will have been removed.

Steam was used to thaw out the ice and it was then swept out of the house, while the floors were scrubbed off with the hot steam. The boilers were cleaned, and engines which had been stalled when the water filled the house had their fires rekindled and were cleaned.

State Employees Rested.

After laboring incessantly for the greater part of the day and night, state employees had an opportunity to rest for a time to-day. All yesterday afternoon and until early this morning a gang of over 100 men and a score of teams were busy drawing stone to Clarissa street bridge, where it was desired to build a dyke which would hold back the water from the feeder and the canal.

The inrush of such a volume of water caused grave fears for the stability of the canal banks, and a dyke at the point named was deemed the best safeguard that could be erected. Five hundred and twenty-two yards of Medina paving stone were drawn to the bridge and thrown over south of the bridge, and at 1 o'clock this morning the workers had the satisfaction of seeing that their efforts were successful.

Division Superintendent Barnard was on the scene for almost forty-eight consecutive hours, and expressed the gravest fears for the consequences, which would follow did the temporary structure fail to hold back the water which entered the feeder above the pest house.

The Lehigh Valley railroad officials were not much pleased with the erection of the dam, as it caused the water to raise over their tracks, but Superintendent Barnard insisted that it was a necessary precaution against the flooding of a large section of territory and great damage to property and the dam remained.

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This morning a section of the dam had washed away, but much of the water was still running up over the railway embankment back into the river south of the bridge, and the railroad employees cut down the crest of the embankment sufficiently to aid in the escape of the water.

Wolcott's distillery still has several feet of water in its cellar and the dam at the bridge does not assist in lowering the level of the water there. At the present time it is impossible to estimate the amount of the damage which has been caused by the flood there.

Park Still Flooded.

There was but little appreciable diminution in the flood at Genesee Valley park. A great portion of the ground is still under water, and the damage to roadways will be extensive. The park employees have been on constant duty to prevent as far as possible serious damage, but the subsidence of the waters will probably reveal a distressing state of affairs.

The boat houses still have considerable water surrounding them, but it is believed no material damage has been done to any of them and that there is no longer any danger that any will be carried away.

Figuring the Damage.

At present it is a matter largely of guesswork to estimate the damage which resulted from the overflow, but it is certain that it will run well up into the thousands and may even reach a total which will be expressed by six figures. Individual losses will take some days to compute, and until a thorough inventory is possible business concerns will be unable to get any exact estimate of the cost of the flood.

In many instances allowance will have to be made for the loss of time sustained by workmen in factories which were compelled to shut down, owing to the flooding of boiler rooms, while the loss to the manufacturers through the closing of the plants will be another important factor.

It is hardly possible that any exact estimate will ever be made of the losses sustained by persons whose homes were invaded by the water.

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DYING FLOOD CAUSES ROW.

STATE AUTHORITIES CLASH WITH LEHIGH VALLEY RAILROAD.

Attempts of Latter to Tear Out Temporary Dam in Feeder Brought to a Halt. — Until Break in Bank is Repaired Trains Will be Tied Up.—Water Falling Slowly.

There is one place where the falling of the waters has failed to restore peace and quiet. This is in the relations between the state authorities and the officials of the Lehigh Valley railroad. On the contrary, there is on just at present a most interesting row, due to the erection of a temporary dam at Clarissa street by the state authorities. This dam caused the water to pour over the railroad tracks, and yesterday morning part of the dam was torn out by employees of the railroad. Later this was restored by the state authorities, who gave it to be understood in no uncertain terms that the dam must stay and that any attempt of the railroad to remove it would be attended with serious consequences. The dam is in place to-day.

When the water rushed down the feeder early Monday morning and made its way into Mt. Hope avenue an ice dam formed in the feeder at a point almost opposite Hamilton street. It was mainly on this account that the flow of water into the canal, which would undoubtedly have been attended with most serious consequences had it continued, was stopped, and early Monday afternoon Division Engineer Houston Barnard had 500 loads of paving stone thrown into the feeder just south of Clarissa street bridge. The rush of water down the feeder was checked, but the railroad tracks were submerged to a depth of several feet, effectually cutting off any running of trains. There was a protest from the railroad, but Engineer Barnard insisted that the city's interests were of more importance than those of the railroad.

Railroad Tears Away Dam.

Part of the railroad roadbed began to be loosened and the railroad authorities yesterday morning had a gang of seventy men at work trying to tear away the dam. They had part of the dam removed when Engineer Barnard heard of what was going on

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and he at once hurried to the scene and ordered the railway company's men to cease work at tearing out the dam. Policemen were also sent for and later in the day the dam was rebuilt where it had been torn away. This morning scarcely any water was finding its way past the dam, and the railroad tracks north of the bridge were clear of water. At a point some 200 feet south of the bridge the water was running over the railroad tracks, although in much less volume than yesterday at the corresponding hour.

Watchers were on hand to see that no further attempt was made by the railroad company to tear out the dam with possible disastrous results to the southeastern section of the city, and preparations were under way looking to the repair of the break in the feeder bank which was the cause of all the trouble.

To Repair Break To-Morrow.

Engineer Barnard, this morning, stated that to-day material would be drawn to a point near the break and a bridge would be thrown across the feeder in order that the actual work of repairing the hole in the break might be begun to-morrow morning. This work will possibly take two or three days.

Several newspapers have insisted on stating that the gates at the head of the feeder had broken under the pressure of the water, thus causing it to rush into the feeder and canal. As stated in *The Union* on Monday the break was in front of what is known as the Welsh farm, two hundred yards south of the pest house, the bank giving way for a distance of about seventy feet. This will have to be filled in with cribbing and earth at the present time, and further repairs may be made later.

When the break has been repaired and tested the dam in the feeder will probably be taken out. Then the Lehigh Valley railroad will get its trains through. It will be remembered that the Lehigh Valley laid its tracks along the feeder bank one Sunday afternoon, six or seven years ago, and that injunction proceedings were talked of, but an amicable agreement was finally reached.

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Engineer Barnard Prevented Deluge.

The importance of the temporary dam built under Engineer Barnard's direction may be understood when it is stated that Commissioner of Public Works McClintock holds that it was the only thing that prevented an overflow that would have entailed great property damage and possible loss of life.

"The feeder is several feet higher than the canal," said Commissioner McClintock in discussing the matter this morning, "and had that dam not been erected there would have been a rush of water down the feeder and into the streets that nothing could have resisted once it started. What the loss would have been in such an event is hard to estimate, but it would have attained figures that would total hundreds of thousands of dollars. That dam certainly saved a most serious flood and Engineer Barnard is entitled to a great deal of credit for the promptness with which he sized up the situation and took measures to prevent further trouble."

Railroads in Better Shape.

With the exception of the Lehigh Valley the railroads are rapidly recovering from the effects of the high water. Trains on the Erie were practically on time this morning, the west track being almost clear of water and the east track being covered only to a depth of a few inches.

Officials of the Buffalo, Rochester & Pittsburg railroad announced this morning that the track between Rochester and Scottsville had been opened to-day, and that trains were practically on time. The whole road is now open for traffic.

In the city engineer's office the readings taken at the Court street dam at noon showed that there has been a total fall of twenty-two inches since 4 o'clock Monday afternoon, and unless there is a change in conditions it is believed that the river will continue to seek its normal level.

Clearing up in the streets visited by the water continues, but it will be the end of the week before all traces of the flood have been removed.

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[*The Union and Advertiser, July 7, 1902.*]

ROCHESTER FACES DANGER OF MIDSUMMER FLOOD.

IMMENSE VOLUME OF WATER RUSHING DOWN THE RIVER, WITH FURTHER RISE LOOKED FOR.

Measurements at Court Street Dam Show Rise of Nearly Three Feet in Twenty-Four Hours. — Unusually Large Amount of Driftwood Coming Down With the Water, Threatening Serious Trouble.

With the river carrying down a volume of water unprecedented for this time of the year Rochester faces the danger of a midsummer flood that has already caused damage amounting into the hundreds of thousands of dollars up the valley, equalling if not exceeding the damage resulting from the memorable freshet of March. Crops have been destroyed, roadways washed out and gullied, houses wrecked and swept away and bridges in numbers have gone down before the rush of the muddy torrent that now hastens towards Lake Ontario. At least two lives have been lost and later reports may swell the list.

Heavy rains on Thursday, Friday and Saturday helped to increase the river's volume, but early Sunday morning cloudbursts at several points up the valley added the finishing touches. Creeks and brooks were transformed into swollen rivers, spreading out over the surrounding country, carrying destruction in their course.

Rochester began to experience the rise of water early yesterday when quantities of driftwood on the river indicated the ravages of the flood. As the day wore on the rise in the river became more noticeable, and to-day the increase in volume has been steady.

At 9 o'clock yesterday morning representatives of the city engineer's office took a reading at the Court street dam, and when this morning's reading was taken at the same hour a raise of 2.2 feet was recorded. This gives a height of 4.14 feet at the dam, or rather above it. On March 3d, when the record was made the height of water was 7.64 feet, or just three and one-half feet higher than at 9 o'clock this morning.

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A further rise of but a few inches will put the water on a level with the Erie railroad tracks, while a raise of a foot above the 9 o'clock measurement means that the railroad tracks will be covered. Both the Erie and Lehigh Valley roads have men watching the river and gangs of men will be in readiness to go to work at any points that may be threatened.

Trees, fence rails and other drift have been coming down in quantities for twenty-four hours past, and each of the city bridges and the aqueduct has one or more large trees lodged against it. Several trees are balanced on the Court street dam near the gate house of the raceway on the west side of the river, while against the gates of the Brown & Seymour race on the east side is lodged a huge pile of drift which constantly grows, despite the efforts that have been made to keep the place clear.

From the trees which make their way down the river, safely passing the bridges, there has arisen a new danger not experienced in the spring freshets. Floating out into the lake in large numbers, more or less submerged, the trees offer a serious menace to navigation, and yachtmen coming into Charlotte harbor last night reported a number of narrow escapes.

No little anxiety is manifested as to the giving way of the feeder bank, the place at which the freshet broke through in March. The opening in the bank made at that time has been closed and tested, but there has been no such test as the present freshet gives and persons in the vicinity of the break are more or less alarmed.

Should another break occur at this point there would be serious trouble for the patients confined at Hope Hospital. There are some fifty patients in the hospital and the tents, aside from the nurses and attendants, and as the site of the hospital is low ground an overflow would inundate the hospital grounds.

Rochester's rainfall also contributed to the rise in the river's level, the total amount for the twelve hours between 6 p. m. Saturday and 6 a. m. Sunday being 1.11 inches.

All day yesterday when the rise in the river first became apparent and to-day the river bridges have contained numbers of curious and interested spectators and the appearance of each

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tree or heavy bit of drift was the signal for a rush from one side of the bridge to the other to note the progress of the drift.

All the towns along the river report great damage and at Fillmore and Arcade deaths are reported, while from other points persons are reported missing. Of the damage to crops and roadways it is hard to make any estimate, but that the total loss along the Genesee will mount up to several hundred thousands of dollars there is not the slightest doubt, farmers uniting in the opinion that it is one of the most disastrous, if not the most disastrous, freshets ever experienced in the valley of the Genesee.

[*The Union and Advertiser, July* 8, 1902.]

FURTHER RISE IN THE RIVER.

VOLUME OF WATER FROM HIGHER UP MAKES PRESENCE FELT.

Rise of More Than a Foot Since Six O'Clock Last Evening, and Rise Continues. — City Engineer Fisher Tells of Flood Up the Valley. — Making Pictures of the Torrent.

Rochester has not yet escaped the danger of a midsummer flood. Since yesterday morning at 9 o'clock, when a rise of over two feet within twenty-four hours had been recorded, there has been a steady increase in the volume of water that has passed through the city and a further rise of over a foot has been recorded and the rise continues. Later reports from points up the valley indicate that the first estimates of damage were not too large and revised figures may carry the total loss to even higher amounts.

Railway service entering the city is still uncertain on some of the roads, and the Pennsylvania is entirely out of business as far as operating on the branch formerly known as the Western New York & Pennsylvania is concerned. Damage to other roads is being repaired as rapidly as possible and unless there are further rains it hoped to have the roads in shape within forty-eight hours.

The Buffalo, Rochester & Pittsburg is at present transferring Rochester division passengers at Bliss, near which a number of bridges were carried away, but by to-morrow or the next day it

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is expected that temporary bridges will be in place and traffic resumed.

City Engineer Fisher returned to the city last night from Angelica and he has an interesting story of the ravages of the flood to relate. He says that the water works and natural gas systems in a number of the towns have been completely carried away. The water is claimed by residents of the several towns to have exceeded in height and volume anything ever witnessed there in previous years. Mr. Fisher could not state positively whether Rochester had experienced the highest water that it would, but expressed the hope that no further damage would result.

Commissioner of Public Works McClintock has been a close observer of the flood and under his direction a number of views of the high water and obstructions at various points have been made and these will be available for the use of the Flood Commission.

At the office of the park board it was stated that the water had spread out over the road at Genesee Valley park just south of the Elmwood avenue bridge covering the former site of the merry-go-round, but that it had not yet reached the meadows. No damage of moment has been caused to the park lands as yet.

The rise in the river was noted with alarm by members of the various boat clubs which have houses along its banks at Genesee Valley park, and docks were anchored and boats removed from possible danger, although parts of one or two docks were carried away so sudden was the increase in the river's volume.

The high water in the river is causing more or less inconvenience in Charlotte and some danger, though the river is not over its banks there. The ferry boat Windsor is tied up to-day and will probably remain out of commission to-morrow on account of two big logs, one of which is caught in her chain and the other under her. The tug Yates is working away at the logs and it is hoped to get the craft running in a few days.

Last night the steamer Charlotte, owned by J. D. Scott of this city, broke from her moorings on the east side of the river opposite the village and was being carried down against the railroad bridge when her anchor was dropped and she was saved.

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A moment later and she would have been stove in by the sharp end of the bridge pier.

The Yates coal chutes are closed down on account of lack of coal. None is being received at the chutes, washouts along the B., R. & P. road preventing moving of trains.

[*The Union and Advertiser, July* 9, 1902.]

RIVER DOES NOT RECEDE.

CELLARS IN FRONT STREET ARE FILLED WITH WATER.

Little Probability of Any Immediate Diminution in the Volume of the Torrent. — Part of the Park Lands Are Under Several Feet of Water. — Railway Tracks Covered.

There has been no recession in the river since yesterday afternoon, when the high point was reached, in fact, a rise of half an inch was recorded at 7.30 o'clock this morning, and at that level the flood appeared stationary. There has been some rain up the valley, so that no immediate fall is looked for, and a further rise may be anticipated should any more rain fall.

City Engineer Fisher this morning expressed the belief that it would be some time before there was any noticeable fall in the level, and did not care to predict what might happen in case of continued rainfall. He expressed some little satisfaction at the absence of driftwood during the last twenty-four hours, considering that a favorable indication.

Cellars in Front street are to-day experiencing a repetition in a measure of the trouble in March. Most of the buildings at the low end of the street have several feet of water in the cellars, and requests have been made by one or two firms to the fire department for the use of fire engines to pump out cellars.

Early this morning the Central Light and Power Company was in trouble, and for a period of several hours electric lights on the company's circuit were crippled, but shortly after 8 o'clock they were in running order once more.

The Erie railroad tracks along the west bank of the river are under water for a distance of several hundred feet north of

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Clarissa street bridge and just south of the bridge the water has rushed in against the tracks. Trains are being operated as usual, although the water covers the outer track to a depth of at least a foot.

At Genesee Valley park a large part of the low land is under water, the river road and the two baseball fields being covered with water to a depth of three or four feet. No particular damage has as yet resulted, however.

Members of some of the boat clubs with quarters near Elmwood avenue bridge found a new sort of amusement last evening in shooting the Elmwood avenue bridge, between the arches of which the water was rushing at a terrific rate. From a point well up stream the canoes were launched and headed for the middle arch, through which they plunged at a speed rivalling that of a fast train.

The Pennsylvania railroad is still tied up. As in March water has found its way into the basin of the old Genesee Valley canal and the railroad tracks are covered with water down as far as Troup street. In some places in the basin the water lies three feet deep over the tracks and affords a course for raft contests between adventurous youngsters.

Down at Charlotte there has been no improvement in condition during the last twelve hours. The ferry boat has succeded in freeing its chain from the driftwood which caused its retirement from business yesterday, but the current still runs at a rate that makes navigation a matter of difficulty.

Steamers experienced considerable difficulty last night in making their landings, and the bathing at the lake resorts has suffered a setback owing to the quantity of drift that has been brought down by the river.

Considerable difficulty was experienced by the steamer Kingston in making the Charlotte harbor last evening on account of the strong current in the river caused by the flood. The boat made three attempts before she was able to enter the river between the two piers. While going to the docks the vessel struck the chain of the ferryboat Windsor and was compelled to back water for some time. The Kingston also struck the steam yacht

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Navajo, which is owned by Charles M. Everest of this city, smashed one side of the yacht and also one of her lifeboats, inflicting damages amounting to $200. After the accident the Kingston was towed to her dock by the tugs Yates and Proctor, which saved her from being rammed by the stone piers. The steamers Toronto and Arundell also experienced some trouble in making the harbor last night.

[*The Union and Advertiser, July* 10, 1902.]

RIVER BEGINS TO RECEDE.

OVER FOUR INCHES FALL RECORDED IN TWELVE HOURS.

Fall May be as Rapid as Rise, Now That Water Up the Valley Has Lowered. — Railroads Getting Schedules Into Shape Again. — Highways In Bad Condition.

Apparently danger from the high water has passed. After remaining practically stationary for over thirty hours the water has begun to recede, and in twelve hours a fall of something over four inches was registered at the Court street dam, and it is hoped that the fall will be quite as rapid as was the rise.

There have been rains up the valley, but reports from far up indicate that the streams which empty into the river are going back within their banks and the water which had spread out, turning the surrounding country into ponds and lakes, is rapidly draining off, so that the volume of water in the river is decreasing at a rapid rate.

The railroads which have been bothered since Sunday by the high water are rapidly getting back into shape, and train service is being maintained without interruption, but extensive repairs to roadbeds will have to be made by several of the roads which enter Rochester.

Highways throughout the surrounding country are in terrible shape, the recession of the water making apparent the extent to which the roads have been cut to pieces by the sudden rush of water over them. This is especially the case with the roads

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lying adjacent to the river and its tributary streams, and it will be weeks before the roads are in condition again.

Water in the cellars along Front and Water streets is much lower to-day, in many cases all that entered yesterday having run out, as the fall in the river made it possible for sewers to better discharge their contents into the river.

At Genesee Valley park water still covers the baseball grounds and a large part of the low land, but with a few days of dry weather the work of the water will be repaired. Boating may still be enjoyed over part of the park not usually accessible in boats, and there will be no baseball for some time to come on the park diamonds.

At Charlotte conditions have improved somewhat, and this morning the steamer Kingston, which was in difficulty yesterday, was enabled to get out of the river and will resume its regular trips, making landings at the west, or Charlotte pier.

Exhibit No. 11.

U. S. DEPARTMENT OF AGRICULTURE.

NEW YORK SECTION

OF THE

Climate and Crop Service

OF THE

WEATHER BUREAU.

IN COOPERATION WITH

CORNELL UNIVERSITY.

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Report for February, 1902.

WEATHER AND CROPS.

February was a cold month with much snow and high winds, followed by a general thaw after the 23d, the ground being bare on the 28th, except in the colder sections. The weather was generally favorable for crops, and winter wheat, rye, grasses, and fruit trees were in good condition, except in the southeast, where much damage to forest and fruit trees was done by the sleet storm of the 21st and 22d.

TEMPERATURE.

The mean temperature for February, 1902, as determined from records of 93 stations, was 20.9°, or 2.2° below the normal, which, added to the accumulated departure since November 1, 1901, gives a total departure from that date to February 28, 1902, of 10.3° below the normal, which deficiency represents a very cold winter. The highest local monthly mean was 28.5° at New York city, and the lowest was 14.8° at Axton in the Adirondacks. The maximum for the month was 68° at North Lake, on the 28th, and the lowest was —26° at Axton, on the 11th. The mean for the month was 28° on Long Island and in the vicinity of New York city, 18° to 20° in the Catskills, 20° to 22° along the Great Lakes, and 15° to 17° in the Adirondacks. The temperature was about or below zero in the colder sections of the State on the 4th, 5th, 6th, 7th, 10th, 11th, 12th, 13th, 14th, 15th, 16th, 19th, 21st, 22d, and in the early morning of the 24th, followed on the last-named date by much warmer weather, which continued to the end of month, the maxima on the last two days being generally about or above 50° and over 60° in places.

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The mean temperature for each February during the last 14 years is given in the following table:

1889	18.5
1890	29.8
1891	27.6
1892	25.3
1893	20.5
1894	20.3
1895	17.2
1896	22.8
1897	24.6
1898	26.3
1899	20.5
1900	22.7
1901	16.1
1902	20.9

PRECIPITATION.

The average precipitation, as determined from the records of 118 stations, was 3.07 inches, or 0.10 inch above the normal for February. While the average for the State was about normal, the precipitation was very light over a large section, being less than 1 inch in parts of Chautauqua, Yates and Niagara counties, but this deficiency was more than offset by the heavy amounts on Long Island and in the lower Hudson Valley, where 5 to 8 inches were reported. The largest amount reported at any station was 8.24 inches at Salisbury Mills, and the least was 0.73 at Westfield No. 3.

The average precipitation for each February during the last 14 years in New York State is given in the following table:

1889	4.22
1890	3.57
1891	4.02
1892	2.18
1893	4.64
1894	2.84
1895	1.66
1896	5.52

the 3d, while the total movement at [illegible]
miles, with a maximum velocity of 35 miles per hour from the

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1897	1.86
1898	2.96
1899	2.47
1900	3.87
1901	1.44
1902	3.07

SNOWFALL.

Snow was frequent during the first 20 days of February, and was heavy in parts of western and northern New York on the 2d, 30 inches falling at Axton on the 2d and 3d, 17 inches at Keene Valley on the same dates, and 18 inches at Rome on the 3d.

Heavy snows were general in eastern New York on the 17th, the fall on that date ranging from 10 to 20 inches. In the southeast section heavy snow also occurred on the 21st and 22d, 21 inches falling at Middletown, 14 inches at Carmel, 9 inches at Catskill, 12 inches at Wappingers Falls, and corresponding depths at other stations in that section. It was this snow storm that caused the severe sleet storm that did so much damage to railroads and telegraph and telephone lines in the vicinity of New York city and the surrounding country. The total snowfall during the month was 10 to 18 inches on Long Island, 20 to 33 inches in the Catskills, 25 to 54 inches in the Adirondacks, 30 to 40 inches in Madison and Oneida counties, with various depths from 4 to 30 inches in other sections. Warm weather began on February 24th, and the snow melted rapidly, the ground being bare on February 28th, except in the colder sections.

WINDS.

The prevailing winds were from the west. The total wind travel for the month was 15,266 miles at New York city, at which station a maximum velocity of 74 miles from the west occurred on the 2d. The total movement at Buffalo was 11,528 miles, with a maximum velocity of 63 miles from the west on the 3d, while the total movement at Binghamton was 5,756 miles, with a maximum velocity of 35 miles per hour from the

west on the 2d. The average hourly velocity during the month was 22.7 at New York, 16.0 at Buffalo, and 7.8 at Albany. An unusually severe storm passed over New York State on February 2d and 3d. In western New York the storm began on the afternoon of the 2d, and continued until next morning in western New York, and during the entire day in eastern New York. The wind velocity in parts of the State was the highest in several years, and much damage to property was reported. An extreme velocity of 60 miles occurred at Ithaca, completely disabling the street car plant. It was also a very windy period from the 8th to the 10th, and from the 17th to the 19th. The winds were light with the warm weather during the last few days of February, but severe winds again resulted on the 28th, in advance of the severe storm central on that day in Iowa, where the barometer, reduced to sea level, read 28.68.

GENERAL SUMMARY FOR FEBRUARY, 1902.

TEMPERATURE.

	Degrees.
Mean temperature (determined from records of 93 stations)	20.9
Departure from normal	—2.2
Highest local monthly mean (at New York city)	28.5
Lowest local monthly mean (at Axton)	14.8
Highest temperature (at North Lake, on 28th)	68
Lowest temperature (at Axton, on 11th)	26

PRECIPITATION.

	Inches.
Average precipitation (determined from records of 118 stations)	3.07
Departure from normal	+0.10
Greatest amount recorded at any station (at Salisbury Mills)	8.24
Least amount recorded at any station (at Westfield 3)	0.73
Average number of days on which 0.01 inch or more fell	9

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WIND.

Prevailing wind direction	W.

WEATHER.

Average number of clear days	10
Average number of partly cloudy days	8
Average number of cloudy days	10

MISCELLANEOUS PHENOMENA (DATES OF).

Auroras.— 3, 28.
Coronae.— 4.
Fogs.— 15, 16, 17, 18, 21, 26, 27.
Hail.— 2, 21, 22.
Lunar Halos.— 13, 16, 24.
Solar Halos.— 6, 7, 14, 15, 16, 20.
Parhelia.— 20, 22.
Sleet.— 2, 21, 22.
Thunderstorms.— On the 27th, at 2 stations; 28th, 10.

ATMOSPHERIC PRESSURE, RELATIVE HUMIDITY, AND WIND FOR FEBRUARY, 1902.

STATIONS.	BAROMETER, IN INCHES.					MEAN RELATIVE HUMIDITY, PER CENT.	WIND.			
	Mean.	Maximum	Date.	Minimum.	Date.		Total movement, miles	Maximum velocity, miles.	Direction.	Date.
New York	29.85	30.24	20	28.99	17	73	15,266	74	w.	2
Albany	29.88	30.38	20	29.00	2	83	5,699	47	w.	3
Binghamton	29.88	30.33	20	29.28	2	.....	5,756	35	w.	2
Rochester	29.90	30.38	*14	29.26	28	81	7,665	42	w.	3
Buffalo	29.92	30.41	14	29.07	28	78	11,528	63	w.	3
Oswego	29.87	30.33	20	29.20	2	85	9,409	52	nw.	3
Erie, Pa	29.94	30.45	14	29.12	28	.....	7,946	48	s.	28
Ithaca	29.94	30.40	20	29.41	18	80	6,584	50	w.	2

The voluntary station at Mayle, Niagara county, has been closed. A new rainfall station has been opened at Youngstown, Niagara county. The volunteer observer will be Mr. Byron E. Tower, who will begin making records on April 1st.

SUPPLEMENTAL TABLE, FEBRUARY, 1902.

STATIONS.	Total precipitation.	Mean temperature.	Observers.
Adams Center	7.44	.....	A. E. Cooley.
Akron	1.71	.....	H. A. Wilder.
Blue Mountain Lake	2.20	.....	B. F. Merwin.
Boyd's Corners	6.81	.....	Thomas Manning.
De Kalb Junction	2.17	.....	C. A. Hallegas.
Easton	2.32	.....	H. Taber.
Gansevoort	3.00	.....	R. E. Cronkhite.
Haskinville	1.26	.....	Walter G. Collins.
King Ferry	1.99	.....	L. A. Goodyear.
Lyndonville	1.39	.....	Frank Plummer.
Mayle	1.99	.....	Andrew R. Laur.
Newark Valley	2.04	.....	M. D. Clinton.
North Hammond	2.20	.....	C. A. Wooster.
Old Chatham	4.64	.....	Hugh Van Alstyne.
Port Byron	2.90	.....	Geo. V. Roberts.
Red Hook	3.92	.....	E. S. Webber.
Salisbury Mills	8.24	.....	H. P. Ramsdell.
Skaneateles	2.44	.....	Edward Conron.
S. E. Reservoir	3.63	.....	Thomas Manning.
Speculator	3.45	.....	Lyman Slack.
Spier Falls	2.32	.....	Geo. E. Evans.
Warwick	6.81	.....	John W. Sly.
Wolcott	2.60	.....	L. W. Lane.

OBSERVERS' REMARKS.

Angelica.— Streams gorged and ice jams formed on the 28th. Streets and cellars flooded. Railroad traffic suspended for nearly a week. Water is as high as at time of Johnstown flood.

Atlanta.— Heavy snows with high winds on 2d; railways blocked.

Avon.— High winds with snow on the 2d, 3d and 4th; snow badly drifted.

Humphrey.— A severe gale on the 2d and 3d; most severe storm for years. Country roads blocked for 10 days.

South Canisteo.— Month ends with a flood.

Wedgewood.— Snow badly drifted first of month.

Meredith.— Country roads blocked; snow drifts 15 feet high in places.

New Lisbon.— Heavy rain and thunderstorm on the 28th.

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Perry City.— High water on the 28th damaged farm lands and washed away bridges.

Port Jervis.— Thunderstorm on the 28th.

The stations at New Rochelle and at Westfield No. 1 have been closed.

Mr. J. E. Wakeman has succeeded The Trevor Manufacturing Co. as voluntary observer at Lockport, N. Y.

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AVERAGE HOURLY WIND MOVEMENT FOR FEBRUARY, 1902.

STATION.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	12 noon.
Albany	7.4	6.9	7.0	6.6	6.6	6.8	7.4	7.3	8.2	9.3	9.6	10.2
Buffalo	16.2	15.8	16.5	17.9	17.3	16.8	16.9	16.7	16.7	16.6	16.8	17.6
Ithaca	8.5	8.5	8.6	9.4	10.0	9.5	9.4	9.3	9.3	10.2	10.5	10.1
New York City	22.3	22.0	20.5	20.6	20.2	20.2	19.7	21.4	21.0	22.0	23.2	22.2
Northfield, Vt.	6.9	6.4	5.4	6.0	6.1	6.0	7.1	6.6	6.1	7.2	8.5	9.8
Oswego	13.8	13.4	13.6	13.4	13.5	13.9	14.0	13.2	13.9	14.8	14.8	14.5
Rochester	9.9	9.7	9.9	9.8	10.4	10.1	10.7	10.7	11.6	11.9	12.3	12.9

PREVAILING HOURLY WIND DIRECTION.

Albany	nw.	n.	n,nw.	n.	n.	n,nw.	n.	n.	n.	nw.	nw.	nw.
Binghamton	w.	w.	w.	ne,w.	ne,nw.	w,nw.	w.	ne,w.	†	w.	nw.	w.
Buffalo	sw,w.	w.	w.	sw.	w.	sw.	w,sw.	sw.	w.	w.	w.	w.
Ithaca	w.	se,nw.	se.	se.	nw.	se.	e.	nw.	w,nw.	w.	nw.	*
New York City	nw.	w,nw.	w,nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.
Rochester	sw.	sw.	sw.	sw.	sw.	sw.	sw.	sw.	sw.	sw.	sw.	sw.

* SE, W, NW. † NE, W, NW.

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AVERAGE HOURLY WIND MOVEMENT FOR FEBRUARY, 1902 —(*Continued*).

STATION.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	12 midnight.	For the month.
Albany	10.4	10.7	10.8	9.8	10.2	9.2	8.6	8.2	8.8	7.8	7.8	7.8	8.5
Buffalo	18.5	19.1	19.2	18.4	18.1	17.4	17.2	17.2	16.5	16.4	16.1	16.0	17.2
Ithaca	11.0	11.1	11.4	11.5	10.9	9.9	9.4	9.2	9.4	9.5	9.5	8.9	9.8
New York City	23.0	24.8	25.9	25.4	24.4	24.5	24.7	25.1	24.9	23.3	22.0	22.0	22.7
Northfield, Vt	10.2	10.8	9.8	9.2	8.5	8.5	8.8	8.0	7.5	7.0	7.0	6.4	7.5
Oswego	15.0	14.4	14.4	14.8	14.2	14.1	14.5	13.9	13.6	14.2	13.6	13.2	14.0
Rochester	13.5	13.4	13.4	13.4	12.6	11.7	11.3	11.4	11.2	11.0	10.6	10.3	11.4

PREVAILING HOURLY WIND DIRECTION —(*Continued*).

Albany	n.	nw.	w,nw.	w,nw.	nw.	w.	nw.	nw.	n.	n,nw.	nw.	nw.	nw.
Binghamton	w.	nw.	w,nw.	nw.	w.	nw.	w.	w.	nw.	w.	w.	w.	w.
Buffalo	w.	w.	w.	w.	w.	w.	w.	w.	w.	w.	w.	w.	w.
Ithaca	se.	w.	nw.	nw.	w.	nw.	nw.	se.	nw.	w.	w.	w.	nw.
New York City	nw.	nw.	nw.	nw.	w,nw.	nw.	nw.	nw.	nw.	nw	nw	nw.	nw
Rochester	w.	‡	‡	w,nw.	w.	w.	w	sw.	sw.	sw.	sw.	w.	sw.

‡SW, W, NW.

CLIMATOLOGICAL DATA FOR NEW YORK, FEBRUARY, 1902.

STATIONS.	Counties.	Elevation, feet.	Length of record, years.	TEMPERATURE, IN DEGREES FAHRENHEIT.						
				Mean.	Departure from the normal.	Highest.	Date.	Lowest.	Date.	Greatest daily range.
Western Plateau:										
Addison	Steuben	1,000	12	22.4	—2.2	54	28	—10	16	47
Alden	Erie	.....	2	20.6	.....	55	28	—4	16	28
Angelica	Allegany	1,340	18	18.9	—2.6	58	27	—18	*15	57
Atlanta	Steuben	1,200	11	19.3	—1.4	50	28	—11	16	45
Avon	Livingston	585	7	19.8	.....	57	28	—7	6	30
Bolivar	Allegany	1,800	6	18.0	.....	50	27	—19	15	49
Elba	Genesee	500	2	18.6	.....	46	28	—2	6	27
Elmira	Chemung	863	22	23.2	—3.1	49	28	1	16	33
Franklinville	Cattaraugus	1,598	5	17.6	.....	50	27	—16	16	50
Hemlock Lake	Livingston	900	3	21.0	.....	52	28	—5	16	33
Humphrey	Cattaraugus	1,950	18	17.8	—5.7	47	*26	—8	5	36
Jamestown	Chautauqua	1,328	6	20.2	.....	54	28	—10	*14	45
Nunda	Livingston	.....	.....	21.8	.....	56	28	—5	*15	37
Shortsville	Ontario	740	2	21.4	.....	53	28	—1	6	29
South Canisteo *a*	Steuben	1,480	12	20.6	—3.4	55	23	—11	15	52
Wedgwood	Schuyler	1,430	12	19.7	—4.1	45	*23	—3	*5	31
Eastern Plateau:										
Binghamton	Broome	875	11	21.2	—2.8	51	27	—6	6	38
Bouckville	Madison	1,350	4	20.0	.....	53	28	—7	6	29
Cooperstown	Otsego	1,250	48	18.6	—2.4	46	*27	—12	6	33
Cortland	Cortland	1,130	41	23.6	+1.4	48	*27	—10	16	36
Griffins Corners	Delaware	.....	.....	21.0	.....	57	27	—9	6	49
Meredith	Delaware	2,260	.....	17.7	.....	47	27	—5	6	27
Middletown	Orange	700	11	22.8	—2.4	48	27	5	6	27
Mohonk Lake	Ulster	1,245	6	22.3	.....	48	27	2	6	25
New Lisbon	Otsego	1,234	11	18.0	—2.6	53	28	—18	6	43
Oneonta	Otsego	1,100	6	22.0	.....	57	27	—9	6	43
Oxford	Chenango	958	38	20.5	—2.6	51	28	—12	6	38
Perry City (near)	Schuyler	1,038	12	19.8	—2.9	49	28	—10	6	42
Port Jervis	Orange	470	17	24.5	—1.4	55	27	0	6	39
Richmondville	Schoharie	500	3	20.6	.....	55	28	—5	6	32
South Kortright	Delaware	1,441	13	19.8	—2.5	53	27	—11	6	50

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Straits Corners *b*	Tioga	600	5	19.1	.....	45	*27	—9	6	45
Walton	Delaware	.....	.....	20.8	.....	51	27	—9	6	45
Waverly	Tioga	824	20	22.4	—2.2	49	*27	—3	*6	40
West Berne	Albany	600	3	22.4	.....	64	28	—8	23	55
Windham	Greene	1,520	2	20.0	.....	54	25	—10	23	51
Northern Plateau:										
Adirondack Lodge	Essex	2,224	.....	15.0	.....	50	27	—12	14	39
Axton	Franklin	1,600	2	14.8	.....	56	27	—26	11	53
Gabriels	Franklin	1,800	.....	17.0	.....	52	28	—8	11	40
Gloversville	Fulton	850	10	18.8	.....	48	26	—11	6	32
Indian Lake	Hamilton	1,705	2	17.2	.....	56	26	—21	6	60
Keene Valley	Essex	1,000	5	19.2	.....	52	*27	—17	7	46
Little Falls 2 *b*	Herkimer	1,526	5	19.6	.....	53	27	—19	6	44
Lowville	Lewis	900	36	18.2	—2.0	48	27	—10	6	34
North Lake *c*	Herkimer	1,822	5	15.8	.....	68	28	—25	6	54
Number Four	Lewis	1,571	13	17.2	+0.1	53	27	—17	11	35
Saranac Lake (near)	Essex	1,750	8	17.5	.....	54	28	—14	7	50
South Schroon	Essex	1,225	.....	19.5	.....	52	27	—10	16	40
Wells	Hamilton	850	.....	19.2	.....	55	27	—25	6	51
West Chazy	Clinton	.....	4	18.0	.....	45	*25	—14	*6	31
Atlantic Coast:										
Bedford	Westchester	290	8	25.4	.....	54	27	5	6	28
Cutchogue	Suffolk	32	3	28.4	.....	50	27	12	24	31
New York City	New York	314	31	28.5	—3.0	54	28	11	5	16
Primrose	Westchester	200	5	27.2	.....	52	28	5	6	27
Setauket	Suffolk	40	16	28.2	—1.8	54	28	14	*5	20
Southampton	Suffolk	.....	1	28.0	.....	48	27	11	5	21
Hudson Valley:										
Albany	Albany	97	74	23.6	—0.6	49	27	3	6	32
Athens	Greene	.....	.....	.....	.....	.....	.....	.....	.....	.....
Canaan Four Corners	Columbia	.....	.....	20.7	.....	51	27	—1	6	32
Carmel	Putnam	500	10	24.4	—2.8	54	27	3	*6	42
Catskill	Greene	450	5	25.2	.....	50	27	2	6	31
Cedar Hill	Albany	208	3	23.8	.....	52	27	0	6	37
Greenwich *b*	Washington	425	4	22.2	.....	54	28	—4	20	31
Honeymead Brook	Dutchess	450	21	24.4	—0.3	52	27	3	6	34
Wappingers Falls	Dutchess	110	9	23.9	.....	52	27	—6	20	46
Mohawk Valley:										
Canajoharie	Montgomery	300	5	22.0	.....	54	27	—13	6	44
Little Falls 1	Herkimer	924	5	19.3	—0.4	54	28	—7	6	26
Rome	Oneida	445	12	21.0	.....	44	*27	—11	6	26
Champlain Valley:										
Caldwell	Warren	350	5	20.1	.....	49	28	—7	*6	32
Carvers Falls	Washington	243	4	17.1	.....	52	28	—12	6	34
Glens Falls	Warren	340	10	22.8	.....	50	28	—2	6	27

* Also on subsequent dates. *a*, *b*, *c*, etc., indicate number days missing from reports.

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CLIMATOLOGICAL DATA FOR NEW YORK, FEBRUARY, 1902 — (*Continued*).

STATIONS.	Counties.	Elevation, feet.	Length of record, years.	TEMPERATURE, IN DEGREES FAHRENHEIT.						
				Mean.	Departure from the normal.	Highest.	Date.	Lowest.	Date.	Greatest daily range.
Champlain Valley—(Continued):										
Plattsburg	Clinton	125	32	18.6	+0.2	48	28	—10	6	34
Saratoga Springs	Saratoga	314	5	22.4	.....	51	28	—4	6	31
Ticonderoga	Essex	128	4	22.4	.....	54	28	—5	*7	43
St. Lawrence Valley:										
Canton	St. Lawrence	304	38	15.1	—2.9	55	28	—11	15	35
Moira	Franklin	800	2	16.8	.....	59	28	—4	16	30
Ogdensburg	St. Lawrence	258	11	20.0	.....	55	28	—1	6	30
Watertown	Jefferson	486	9	20.5	.....	50	28	—3	11	29
Great Lakes:										
Appleton	Niagara	270	13	22.5	—1.6	52	28	0	*5	33
Baldwinsville	Onondaga	385	23	22.0	.....	47	24	—9	6	26
Brockport	Monroe	537	2	20.3	.....	50	28	—1	*6	28
Buffalo	Erie	768	42	22.2	—2.3	57	28	4	5	22
Lyons *b*	Wayne	426	14	23.6	—2.0	52	28	2	6	29
Oswego	Oswego	335	31	22.5	—2.1	46	28	—4	6	23
Palermo	Oswego	460	42	.....	.....	45	27	—1	23	24
Ridgeway	Orleans	.....	5	20.8	.....	49	28	1	5	30
Rochester	Monroe	523	31	22.4	—2.0	55	28	3	5	26
Volusia	Chautauqua	1,167	2	19.6	.....	55	26	—6	5	31
Westfield 2	Chautauqua	867	3	20.4	.....	53	28	—3	5	26
Westfield 3	Chautauqua	568	3	20.8	.....	48	27	—1	16	30
Central Lakes:										
Auburn	Cayuga	715	39	22.4	—2.6	54	27	0	*5	36
Fayetteville	Onondaga	.....	.....	22.3	—2.6	52	28	—4	6	36
ITHACA	Tompkins	836	23	21.4	—3.8	50	*27	—1	*6	34
Penn Yan	Yates	750	58	22.0	.....	53	28	—4	6	34
Romulus	Seneca	719	11	21.9	—2.7	50	28	1	5	28

* Also on subsequent dates. *b* indicates number days missing from reports.

CLIMATOLOGICAL DATA FOR NEW YORK, FEBRUARY, 1902 — (*Continued*).

STATIONS	Counties.	PRECIPITATION, IN INCHES.					SKY.			Prevailing direction of wind.	Observers.
		Total.	Departure from the normal.	Greatest in 24 hours.	Total snowfall (unmelted).	Number rainy days.	Number clear days.	Number partly cloudy days.	Number cloudy days.		
Western Plateau:											
Addison	Steuben	1.42	—0.38	0.56	7.0	9	16	2	10	w.	Dr. H. R. Ainsworth.
Alden	Erie	2.18	.....	0.55	17.8	14	15	1	12	sw.	Ira B. Hawthorne.
Angelica	Allegany	1.80	—0.01	0.55	12.5	9	8	10	10	w.	Prof. Edward Maguire.
Atlanta	Steuben	1.94	.....	0.78	13.5	12	7	6	15	w.	F. D. Crouch.
Avon	Livingston	1.22	.....	0.47	13.5	6	10	8	10	.....	Wm. G. Markham.
Bolivar	Allegany	1.99	.....	0.74	14.3	9	8	11	9	w.	Dr. Dorr Cutler.
Elba	Genesee	2.60	.....	0.60	21.0	7	7	5	18	sw.	Jos. S. Wilford.
Elmira	Chemung	1.46	—0.19	0.77	4.0	4	10	10	8	nw.	Gerity Bros.
Franklinville	Cattaraugus	2.45	.....	0.80	16.8	11	8	3	17	w, sw.	Dr. Jno. W. Kales.
Hemlock Lake	Livingston	2.15	.....	0.70	22.0	5	12	4	12	sw.	D. H. Westbury.
Humphrey	Cattaraugus	3.53	+0.34	1.54	23.0	11	4	7	17	sw.	Charles E. Whitney
Jamestown	Chautauqua	1.89	—1.48	0.70	13.4	12	7	8	13	nw.	G. H. Anderson.
Nunda	Livingston	1.60	.....	1.30	8.0	2	13	3	12	sw.	B. E. Jones.
Shortsville	Ontario	1.35	.....	0.60	11.0	5	6	10	12	se,w,nw	C. H. Latting.
South Canisteo *a*	Steuben	2.37	—0.69	1.17	12.0	7	.....	.....	.....	nw.	James E. Wilson.
Wedgewood	Schuyler	2.02	—0.39	0.66	14.5	11	12	7	9	sw, nw	O. F. Corwin.
Eastern Plateau:											
Binghamton	Broome	2.31	—0.50	0.62	15.3	16	4	11	13	w.	U. S. Weather Bureau.
Bouckville	Madison	4.61	.....	1.00	44.0	15	6	8	14	nw.	L. W. Griswold.
Cooperstown	Otsego	2.89	+0.67	0.90	27.0	10	7	11	10	sw.	G. Pomeroy Keese.
Cortland	Cortland	1.35	—1.01	0.46	5.9	9	8	10	10	nw.	The Standard.
Griffins Corners	Delaware	2.53	.....	0.88	18.5	8	13	4	11	w.	Sylvenus Kelly
Meredith	Delaware	3.04	.....	0.86	20.0	10	9	10	9	w.	Wm. Waller.
Middletown	Orange	4.91	+0.28	1.50	32.0	7	15	5	8	nw.	Dr. Selden H. Talcott.
Mohonk Lake	Ulster	4.32	.....	1.60	27.0	8	9	9	10	nw.	Albert K. Smiley.
New Lisbon	Otsego	2.81	+0.29	0.89	18.2	7	5	9	14	sw.	G. A. Yates.
Oneonta	Otsego	2.97	.....	1.06	24.6	8	15	1	12	sw.	H. W. Lee.
Oxford	Chenango	4.02	+1.48	0.90	34.5	15	4	12	12	s.	John P. Davis.
Perry City (near)	Schuyler	1.46	—0.88	0.45	8.8	9	5	9	14	w.	W. H. Jeffers.
Port Jervis	Orange	6.46	+2.90	2.09	25.5	8	15	5	8	sw.	Prof. John M. Dolph.
Richmondville	Schoharie	3.11	.....	1.63	26.0	8	9	2	17	w.	Miss Asenath France.
South Kortright	Delaware	3.56	+1.26	0.73	29.3	14	7	6	15	w, nw.	S. W. Andrews.

a indicates number days missing from reports.

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CLIMATOLOGICAL DATA FOR NEW YORK, FEBRUARY, 1902 — (*Concluded*).

STATIONS.	Counties.	PRECIPITATION, IN INCHES.					SKY.			Prevailing direction of wind.	Observers.
		Total.	Departure from the normal.	Greatest in 24 hours.	Total snowfall (unmelted).	Number rainy days.	Number clear days.	Number partly cloudy days.	Number cloudy days.		
Eastern Plateau—(Continued):											
Straits Corners *b*	Tioga	2.20	.....	0.85	12.5	11	.....	.....	.....	n.	W. E. Elmendorf.
Walton	Delaware	5.76	.....	2.70	26.0	15	6	10	12	w.	Richmond Garrison.
Waverly	Tioga	2.00	+0.17	0.77	11.1	14	4	11	13	nw.	T. P. Yates.
West Berne	Albany	5.60	.....	2.40	33.5	7	11	10	7	w.	E. B. Haverly.
Windham	Greene	3.88	.....	1.40	27.8	12	7	13	8	nw.	A. R. Mott.
Northern Plateau:											
Adirondack Lodge	Essex	4.61	.....	1.21	43.6	10	8	10	10	.....	H. Van Hovenberg.
Axton	Franklin	3.45	.....	1.31	50.5	8	5	10	13	w.	O. Hayden.
Gabriels	Franklin	2.87	.....	1.00	36.0	12	10	7	11	sw.	A. C. Davis.
Gloversville	Fulton	3.13	.....	1.06	34.0	7	14	1	13	w.	W. McLean.
Indian Lake	Hamilton	2.38	.....	1.00	25.0	11	9	9	10	w.	Frank Pelon.
Keene Valley	Essex	3.50	.....	1.35	35.0	10	11	2	15	nw.	Rev. Jno. Irons.
Little Falls 2 *b*	Herkimer	3.32	.....	1.72	27.0	7	.....	.....	.....	w.	E. Ten Eyck Lansing.
Lowville	Lewis	3.41	+0.81	0.78	31.2	13	9	8	11	s.	Charles J. Rice.
North Lake *c*	Herkimer	4.55	.....	1.50	41.0	7	.....	.....	.....	.....	A. J. Yeomans.
Number Four	Lewis	5.81	+1.91	1.20	53.5	13	7	6	15	.....	B. G. Wray.
Saranac Lake (near)	Essex	2.91	.....	1.05	34.7	15	8	8	12	s.	Jno. Kahlmeyer.
South Schroon	Essex	2.87	.....	1.24	24.5	8	11	5	12	ne, s.	L. W. Whitney.
Wells	Hamilton	2.02	.....	1.00	19.2	5	12	8	8	w.	Geo. Murray.
West Chazy	Clinton	.....	.....	.....	.....	.....	13	9	6	s.	D. P. Harris.
Atlantic Coast:											
Bedford	Westchester	5.95	.....	1.80	23.5	8	20	4	4	.....	Dr. Henry Herbert.
Cutchogue	Suffolk	5.81	.....	1.40	17.5	10	15	5	8	nw.	William A. Fleet.
New York City	New York	5.78	+1.98	1.47	13.4	10	8	9	11	nw.	U. S. Weather Bureau.
Primrose	Westchester	6.38	.....	1.18	16.0	8	5	15	8	.....	W. A. Cornelius.
Setauket	Suffolk	5.7	+1.25	1.21	13.5	8	9	10	9	w.	Selah B. Strong.
Southampton	Suffolk	5.40	.....	2.40	14.5	9	15	7	6	nw.	W. L. Jagger.
Hudson Valley:											
Albany	Albany	3.04	+0.38	0.98	.....	10	7	9	12	nw.	U. S. Weather Bureau.
Athens	Greene	4.52	.....	1.40	23.0	7	10	9	9	nw.	E. C. Brooks.
Canaan Four Corners	Columbia	2.21	.....	0.59	21.0	7	12	8	8	.....	W. W. Mayo.

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Carmel	Putnam	5.13	.....	1.88	25.5	8	15	2	11	nw.	Thomas Manning.
Catskill	Greene	4.88	.....	1.80	19.0	5	5	16	7	nw.	A. D. Wilbur.
Cedar Hill	Albany	2.71	.....	1.14	9.0	7	14	2	12	n.	Schoonmaker & Son.
Greenwich *b*	Washington	1.40	.....	0.57	10.0	.....	11	8	9	w.	Oscar W. Tefft.
Honeymead Brook	Dutchess	3.54	+0.09	0.82	16.7	10	1	16	11	n.	Dr. James Hyatt.
Wappingers Falls	Dutchess	4.93	+0.80	1.22	29.5	9	10	11	7	w.	H. C. Townsend.
Mohawk Valley :											
Canajoharie	Montgomery	2.84	.....	1.97	28.9	7	5	10	13	w.	J. E. Countryman.
Little Falls *i*	Herkimer	2.99	.....	0.70	20.5	9	10	8	10	w.	E. Ten Eyck Lansing.
Rome	Oneida	3.83	+0.10	2.05	33.0	6	14	8	6	w.	W. H. Bingham.
Champlain Valley :											
Caldwell	Warren	2.78	.....	1.18	16.0	5	9	8	11	sw.	Galloway C. Morris.
Carvers Falls	Washington	1.40	.....	0.50	.....	3	19	5	4	.....	W. Fancher, C. E.
Glens Falls	Warren	2.03	.....	0.83	8.7	7	9	6	13	n.	Prof. C. L. Williams.
Plattsburg	Clinton	1.60	+0.03	0.80	16.0	4	20	5	3	s.	Post Surgeon.
Saratoga Springs	Saratoga	3.86	.....	1.34	10.0	5	11	5	12	w.	F. G. Burnham.
Ticonderoga	Essex	2.05	.....	0.88	17.5	6	18	1	9	s.	George De Lano.
St. Lawrence Valley :											
Canton	St. Lawrence	2.85	+0.24	1.00	22.0	4	13	4	11	w.	C. W. Bolton.
Moira	Franklin	3.08	.....	0.60	28.0	8	12	5	11	e, w.	C. E. McBride.
Ogdensburg	St. Lawrence	0.96	.....	0.24	9.2	11	10	12	6	e.	Dr. William Mabon.
Watertown	Jefferson	2.70	.....	0.78	42.0	13	11	6	11	s.	H. P. Dunlap.
Great Lakes :											
Appleton	Niagara	0.83	—1.43	0.39	.....	7	6	12	10	sw.	H. A. Van Wagoner.
Baldwinsville	Onondaga	3.69	+0.34	0.80	31.2	10	11	8	9	.....	S. C. Suydam.
Brockport	Monroe	1.46	.....	0.50	14.0	7	12	6	10	sw.	W. H. Lennon.
Buffalo	Erie	2.33	—0.51	0.50	20.7	16	1	16	11	w.	U. S. Weather Bureau.
Lyons *b*	Wayne	2.49	+0.13	0.80	22.5	8	.....	.....	.....	w.	Dr. M. A. Veeder.
Oswego	Oswego	1.78	—0.76	0.75	14.0	14	2	5	21	se.	U. S. Weather Bureau.
Palermo	Oswego	1.93	—0.96	0.60	14.2	13	5	12	10	sw.	E. B. Bartlett.
Ridgeway	Orleans	2.62	.....	0.80	22.8	10	10	11	7	w.	M. E. Weld.
Rochester	Monroe	2.51	—0.22	0.80	23.0	11	8	11	9	sw.	U. S. Weather Bureau.
Volusia	Chautauqua	3.17	.....	0.65	.....	12	11	5	12	w.	Benjamin Breads.
Westfield 2	Chautauqua	1.44	.....	0.37	.....	13	.....	.....	.....	.....	John R. Rogers.
Westfield 3	Chautauqua	0.73	.....	0.22	5.0	10	6	9	13	w.	D. H. Beadle.
Central Lakes :											
Auburn	Cayuga	2.07	—0.22	0.94	16.5	10	13	9	6	n, nw.	A. H. Underwood.
Fayetteville	Onondaga	3.26	.....	0.76	29.5	11	12	7	9	se.	Dana H. Wells.
ITHACA	Tompkins	1.41	—0.62	0.66	6.4	13	4	12	12	nw.	SECTION CENTRE.
Penn Yan	Yates	0.78	—0.80	0.50	5.2	4	7	8	13	w, sw.	Ralph L. Eastman.
Romulus	Seneca	1.53	—0.47	0.60	11.0	4	13	9	6	nw.	John H. Coryell.

NOTE. — Mean temperatures are derived from the daily extremes by the maximum and minimum thermometers. All records are used in determining State or district means but State and district departures are determined by comparison of current data of only such stations as have normals.

* Also on subsequent dates. *a*, *b*, *c*, etc., indicate number days missing from reports.

MAXIMUM AND MINIMUM TEMPERATURES FOR NEW YORK, FEBRUARY, 1902.

STATIONS.	1.		2.		3.		4.		5.		6.		7.		8.		9.		10.		11.		12.		13.		14.		15.		16.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max	Min.	Max.	Min.
Western Plateau :																																
Addison	34	22	35	25	26	8	18	0	20	−3	29	−6	24	10	22	11	31	17	27	14	23	7	25	13	24	8	26	6	33	−5	37	−10
Alden	34	25	35	24	24	12	15	4	10	0	22	−1	19	13	20	10	24	18	22	9	20	6	22	10	18	9	20	3	25	−3	22	−4
Angelica	35	15	35	19	24	5	12	−1	14	−8	33	−7	23	−8	19	3	25	14	23	3	21	0	26	12	19	5	13	−5	28	−18	39	−18
Atlanta	32	22	32	22	22	7	15	2	13	−4	25	−6	22	10	16	6	24	15	22	5	18	5	22	8	16	−5	17	3	30	−5	34	−11
Avon	34	20	35	23	23	13	13	4	11	−2	23	−7	22	10	20	10	27	17	25	10	19	9	24	11	19	0	22	4	23	−3	25	−5
Bolivar	30	20	30	21	21	4	12	−2	7	−8	23	−6	21	11	14	2	20	12	19	12	16	0	19	11	17	4	25	−5	30	−19	34	−15
Elba	33	20	28	23	15	10	15	5	10	−1	20	−2	15	14	18	8	24	17	17	9	19	6	22	15	20	10	16	3	20	4	22	−1
Elmira	33	22	36	18	35	12	17	7	15	2	26	4	25	16	21	9	30	18	29	14	21	11	25	17	23	9	23	14	25	7	34	1
Franklinville	31	22	31	20	21	4	12	0	8	−6	23	−7	22	7	14	3	20	13	20	5	16	3	20	8	15	3	18	−2	29	−12	34	−16
Hemlock Lake	34	23	35	23	22	15	16	5	12	2	25	−3	22	12	20	10	28	18	23	10	20	10	27	15	20	10	22	0	27	−3	28	−5
Jamestown	35	22	37	21	27	3	13	−1	11	−6	25	0	26	11	19	5	20	9	22	10	20	2	23	14	17	5	23	−10	33	−5	35	−10
Nunda	35	24	35	25	26	10	16	2	13	−2	26	−4	26	10	25	7	28	17	25	11	25	8	25	15	25	9	27	0	25	−5	32	−5
Shortsville	33	21	34	24	26	11	15	7	14	1	22	−1	24	13	20	10	26	18	24	11	19	10	23	15	19	4	19	10	24	7	29	0
South Canisteo	32	20	35	22	21	7	15	2	15	−5	27	−6	22	10	20	4	26	15	25	11	19	7	23	11	19	7	21	9	35	−11	35	−8
Wedgewood	29	18	32	18	22	8	13	1	12	−3	23	−3	20	11	17	5	25	13	22	7	18	6	20	10	17	5	19	9	25	5	26	6
Eastern Plateau :																																
Binghamton	33	21	36	23	23	8	14	6	13	0	22	−6	23	14	20	9	26	20	21	8	19	8	23	15	17	9	21	14	25	9	34	−4
Bouckville	30	15	34	27	32	13	14	2	13	−2	17	−7	22	5	16	7	24	15	21	11	18	8	22	6	21	5	20	7	24	14	28	−1
Cooperstown	32	18	34	23	23	13	13	2	10	−4	16	−12	24	1	18	10	27	15	21	12	19	10	23	5	17	2	21	7	22	6	20	−11
Griffins Corners	31	14	38	26	30	11	16	2	13	−1	27	−9	25	2	15	6	22	12	22	11	20	5	26	5	19	5	26	6	38	−3	44	−2
Meredith	30	15	35	26	26	9	10	0	6	−2	14	−5	21	6	10	4	20	10	20	5	11	5	18	4	15	3	16	5	20	9	29	2
Mohonk Lake	27	12	34	24	32	12	15	4	13	3	22	2	29	10	22	8	28	16	28	18	24	7	23	9	24	10	29	11	32	11	36	11
Oneonta	38	18	36	26	26	12	15	2	14	0	24	−9	25	5	19	9	26	18	27	11	24	11	25	12	21	8	24	10	32	13	36	−4
Oxford	34	17	36	27	32	13	17	1	14	0	20	−12	22	4	20	7	28	15	26	12	21	9	26	1	23	3	25	6	26	14	33	8
Perry City (near)	36	18	37	25	25	10	15	1	12	−2	23	−10	23	5	20	5	28	15	25	10	20	3	29	9	20	0	22	9	25	6	34	−8
Port Jervis	31	17	35	29	29	15	17	7	18	4	29	0	31	8	22	10	31	21	30	18	23	11	29	9	29	11	33	15	40	10	32	5
Richmondville	39	14	45	25	32	11	13	4	11	0	15	−5	25	2	18	9	26	12	25	9	18	9	22	9	20	7	19	8	29	9	32	0
South Kortright	35	17	40	30	30	12	12	4	12	0	20	−11	21	1	17	7	24	14	24	10	18	8	24	4	21	4	21	8	30	4	34	−10
Straits Corners	32	17	34	24	25	8	15	3	23	−7	23	−9	22	5	25	9	...	...	...	...	25	1	22	3	17	3	19	9	22	2	30	−5
Walton	32	19	36	25	27	14	14	4	10	−1	24	−9	23	6	18	11	25	11	25	10	18	10	23	7	19	4	21	9	31	11	36	−4
Waverly	36	21	37	27	27	10	18	6	16	−1	29	−5	29	7	22	8	32	20	28	12	23	9	25	8	23	6	26	11	31	11	35	−3
Windham	35	17	39	28	15	12	17	5	12	1	22	−8	23	2	17	7	25	15	23	9	18	6	23	5	21	9	23	8	29	−1	35	−5
Northern Plateau :																																
Adirondack Lodge	26	5	30	24	26	−4	10	−3	10	−4	12	−11	17	−9	14	6	19	6	17	8	13	−10	17	11	17	−1	18	−12	19	−9	26	−9
Axton	27	14	34	25	30	16	14	−20	15	−3	16	−11	22	−11	13	0	24	10	19	−2	18	−26	22	8	19	−7	23	−10	28	−23	34	−3

Gabriel	27	7	32	24	27	5	7	-6	15	0	14	-4	18	-7	13	0	22	7	17	1	15	-8	24	7	17	0	21	4	27	-4	35	-5
Gloversville	26	14	35	26	30	12	14	3	14	3	15	-11	21	-5	20	9	26	14	23	10	10	2	23	-1	22	7	24	6	27	8	26	-5
Keene Valley	30	11	33	28	29	11	21	-6	19	-12	21	-10	23	-17	17	8	27	13	28	10	26	5	29	12	23	-1	30	10	30	-6	32	-14
Little Falls 2	27	12	34	26	2	13	15	1	...	...	19	-19	20	-7	15	7	22	10	22	9	15	-4	...	...	25	3	19	5	25	12	34	-10
Number Four	28	15	32	27	30	10	12	2	10	0	15	-13	18	-2	14	3	20	9	20	-2	15	-17	19	11	16	-3	17	-1	21	-7	29	-6
Saranac Lake	28	8	34	24	28	8	13	-3	16	3	15	-7	21	-14	15	3	23	9	21	2	19	-6	25	10	16	0	23	6	26	-8	37	-13
South Schroon	24	11	31	22	31	12	15	-7	18	-5	17	-7	24	-9	17	6	28	10	27	11	23	-2	23	4	21	1	32	8	28	8	30	-10
Wells	26	13	35	24	33	12	18	-1	18	-2	22	-25	25	-16	18	1	28	12	26	13	21	-8	23	5	27	-5	37	-3	38	-12	35	-15
West Chazy	29	9	32	27	31	10	17	-12	17	1	15	-14	15	-14	14	6	28	14	25	11	23	-4	26	7	20	7	29	17	29	9	22	-9
Atlantic Coast:																																
Bedford	35	28	35	31	32	18	18	12	12	8	26	5	34	10	23	11	33	20	33	20	30	13	29	14	26	13	30	17	34	18	37	14
Cutchogue	35	28	47	33	41	21	26	13	23	16	26	14	38	15	29	17	35	25	35	25	27	15	30	15	34	18	36	20	36	19	38	16
New York City	35	28	30	30	30	15	20	13	18	11	26	13	35	21	25	14	33	25	31	18	25	16	30	19	29	19	34	20	37	21	36	26
Primrose	35	19	39	33	34	19	22	13	20	11	30	5	38	14	26	13	36	22	34	25	28	13	31	15	30	15	33	18	37	15	37	16
Setauket	34	26	45	33	33	19	24	15	19	14	27	14	36	18	26	16	36	24	33	24	26	16	29	17	30	20	33	20	36	22	33	24
Southampton	37	24	47	34	38	21	29	13	20	11	24	13	35	15	33	12	35	23	34	22	32	15	27	15	32	16	33	19	36	18	38	17
Hudson Valley:																																
Albany	28	17	36	27	28	19	19	12	18	7	23	3	28	6	23	16	31	22	28	16	26	10	28	14	23	14	27	15	31	12	32	10
Canaan Four Corners	28	16	36	28	31	15	15	5	10	3	15	-1	25	10	18	10	25	15	24	11	20	5	23	5	20	10	20	8	26	7	34	2
Carmel	33	23	39	32	32	16	18	9	15	8	22	3	31	8	21	10	33	20	32	19	22	8	27	7	26	13	32	16	33	17	37	8
Catskill	21	19	36	30	33	18	19	10	18	8	24	2	27	8	27	16	33	25	37	16	29	14	29	12	28	16	30	16	33	15	33	10
Cedar Hill	31	15	36	26	33	17	20	10	16	7	26	0	25	5	20	13	32	17	30	15	27	10	31	12	25	15	28	15	32	12	34	8
Greenwich	27	16	39	26	34	19	19	9	15	3	16	-3	22	2	20	10	33	16	28	11	21	1	...	...	26	11	26	14	...	...	26	3
Honeymead Brook	34	18	39	31	27	16	21	11	15	9	21	3	31	6	33	22	33	22	34	15	25	8	29	10	24	12	27	15	33	15	35	8
Wappingers Falls	33	18	30	24	35	20	21	10	16	10	22	5	34	9	25	14	34	18	35	16	27	8	28	14	28	14	30	12	33	10	34	10
Mohawk Valley:																																
Canajoharie	33	14	35	25	34	15	17	5	20	3	29	-13	32	-1	18	10	26	14	27	12	25	7	37	10	25	8	24	9	32	15	32	-1
Little Falls 1	28	14	37	25	32	12	14	2	12	2	19	-7	19	4	15	8	27	14	22	9	18	3	22	8	19	6	19	6	18	4	21	3
Rome	30	15	34	28	32	15	15	4	12	4	12	-11	20	4	20	10	26	16	25	5	26	19	24	11	21	8	23	6	25	17	25	2
Champlain Valley:																																
Caldwell	25	16	35	25	32	17	18	4	18	-4	17	-7	23	-6	20	3	36	15	31	8	25	-7	24	3	22	7	32	12	25	-1	26	-3
Carvers Falls	26	14	34	26	33	19	21	0	18	-3	18	-12	18	-9	22	2	26	17	26	7	18	2	19	9	19	0	22	6	21	-4	26	-8
Glens Falls	26	16	36	25	33	20	21	8	21	6	19	-2	24	0	20	8	37	17	32	15	26	2	28	11	21	8	32	13	28	4	28	2
Plattsburg	30	10	33	26	32	10	20	-5	17	-4	17	-10	16	-6	16	5	30	8	29	10	23	2	25	11	24	5	31	11	32	-2	20	-5
Saratoga Springs	28	14	36	27	33	18	22	6	16	4	20	-4	26	0	21	8	34	17	32	15	27	1	29	5	23	9	30	7	31	3	28	1
Ticonderoga	7	14	34	32	33	16	20	-2	24	2	25	2	23	-5	23	15	39	16	33	15	27	1	34	11	23	5	35	13	30	0	34	-4
St. Lawrence Valley:																																
Canton	23	0	31	22	26	7	16	-2	16	2	18	4	20	-7	16	-2	25	15	23	2	20	-5	28	11	14	-10	24	-1	21	-11	25	-10
Moira	20	4	32	20	32	8	10	1	16	5	22	-1	16	-2	13	2	25	12	22	4	19	0	23	9	11	-3	23	3	21	4	26	-4
Ogdensburg	22	6	32	14	25	5	19	0	18	0	17	-1	31	7	17	4	33	14	30	1	21	7	30	10	20	14	25	10	29	11	30	16
Watertown	33	19	36	26	28	14	16	5	19	5	19	3	24	6	20	7	28	14	24	5	24	-3	26	16	20	4	22	4	25	3	25	14

MAXIMUM AND MINIMUM TEMPERATURES FOR NEW YORK, FEBRUARY, 1902 — (*Continued*).

STATIONS.	1.		2.		3.		4.		5.		6.		7.		8.		9.		10.		11.		12.		13.		14.		15.		16.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Great Lakes.																																
Appleton	33	21	34	26	28	13	19	10	15	0	24	2	25	15	25	13	31	24	29	11	22	12	23	16	23	15	25	15	33	4	20	0
Baldwinsville	32	18	35	25	29	14	17	8	14	2	17	−9	23	8	22	11	28	19	25	13	21	12	27	14	23	8	24	12	29	15	31	9
Brockport	34	21	33	24	24	8	14	6	9	0	22	−1	22	14	20	10	25	15	22	9	16	6	23	12	19	11	21	6	27	8	25	−1
Buffalo	32	27	33	21	21	13	14	6	12	4	22	10	25	11	21	10	26	18	20	10	20	10	22	12	16	11	18	6	25	8	20	7
Oswego	31	19	34	22	26	15	19	8	16	4	18	−4	23	13	22	15	27	22	25	14	22	14	23	13	22	11	25	18	26	13	28	11
Ridgeway	33	22	34	24	25	10	18	7	12	1	24	2	24	15	23	10	27	19	24	8	21	7	25	15	19	8	20	9	28	5	25	5
Rochester	34	24	33	24	24	10	17	7	12	3	21	3	23	11	21	11	25	19	21	10	20	10	24	13	19	12	21	9	26	6	30	4
Volusia	33	22	30	22	23	3	12	1	7	−6	23	3	23	10	15	5	18	12	19	10	18	3	20	13	13	4	15	0	28	−1	30	7
Westfield 2	29	24	30	23	23	5	13	3	10	−3	25	5	25	11	17	6	20	14	20	10	20	6	20	15	15	6	16	3	19	4	21	5
Westfield 3	28	25	29	25	25	7	14	6	13	0	24	7	25	14	20	10	22	16	22	11	21	7	22	15	19	9	18	7	22	2	20	−1
Central Lakes:																																
Auburn	32	20	37	13	24	10	17	7	18	0	24	0	25	15	20	10	25	18	23	11	24	10	24	15	21	3	22	8	25	14	36	0
Fayetteville	34	14	37	28	30	13	18	8	17	0	10	−4	25	8	20	10	28	16	22	12	24	10	28	15	22	0	22	2	28	15	34	−2
Ithaca	34	22	34	22	22	12	15	6	15	1	23	−1	24	14	20	10	26	20	21	10	20	11	22	11	17	4	20	15	23	3	32	−1
Penn Yan	34	21	34	24	24	12	16	5	13	0	23	−4	23	12	20	10	26	10	25	11	21	11	24	14	19	4	23	13	25	4	34	0
Romulus	34	21	34	25	27	14	17	7	15	1	23	4	24	5	20	10	27	18	25	11	21	12	24	13	19	8	23	12	25	6	34	6

MAXIMUM AND MINIMUM TEMPERATURES FOR NEW YORK, FEBRUARY, 1902 — (*Continued*).

STATIONS.	17.		18.		19.		20.		21.		22.		23.		24.		25.		26.		27.		28.		29.		30.		31.		MONTHLY MEAN.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Western Plateau:																																
Addison	28	18	25	18	23	5	34	-1	30	18	41	20	48	6	48	21	43	29	45	34	48	29	54	39	...	...	...	...	...	...	32.2	12.6
Alden	24	10	23	10	17	3	27	4	36	17	33	20	40	23	45	30	39	29	43	22	48	29	55	39	...	...	...	...	...	...	27.9	13.4
Angelica	34	8	32	12	21	1	32	-8	33	13	35	13	46	2	51	20	45	28	47	26	58	26	53	40	...	...	...	...	...	...	30.9	6.9
Atlanta	30	13	21	12	16	3	33	1	32	13	38	20	45	4	43	25	42	25	45	27	45	24	50	39	...	...	...	...	...	...	28.6	10.0
Avon	24	10	22	15	16	5	30	2	32	9	31	12	40	11	43	25	40	29	38	25	48	27	57	37	...	...	...	...	...	...	28.1	11.5
Bolivar	28	12	18	12	21	0	30	-7	34	15	34	16	43	-1	48	18	44	26	44	31	50	28	48	39	...	...	...	...	...	...	27.9	8.2
Elba	20	8	22	13	18	3	28	6	32	10	23	10	38	11	40	28	40	26	34	25	45	29	46	36	...	...	...	...	...	...	25.0	12.3
Elmira	31	20	24	18	23	9	29	9	31	20	33	25	41	13	45	12	44	33	39	33	47	31	49	37	...	...	...	...	...	...	30.5	15.8
Franklinville	20	5	19	10	15	1	31	-8	34	11	37	16	44	-1	45	23	42	32	48	21	50	25	49	40	...	...	...	...	...	...	27.4	7.9
Hemlock Lake	28	10	21	11	17	8	29	8	38	12	32	15	42	12	41	30	40	34	42	27	45	30	52	30	...	...	...	...	...	...	28.9	13.2
Jamestown	23	13	21	13	20	3	34	-8	38	20	39	19	43	5	44	28	44	33	53	23	50	25	54	41	...	...	...	...	...	...	30.3	10.2
Nunda	31	11	25	15	25	5	34	0	32	13	33	18	46	9	47	29	45	24	48	25	49	26	56	39	...	...	...	...	...	...	31.6	12.0
Shortsville	24	12	25	15	17	7	28	7	34	14	34	16	40	14	41	30	41	31	38	27	49	28	53	38	...	...	...	...	...	...	28.4	14.3
South Canisteo	29	14	23	14	20	3	38	7	30	17	35	20	55	3	...	...	49	25	50	31	45	25	52	39	...	...	...	...	...	...	30.2	10.9
Wedgewood	25	17	20	13	15	5	29	4	27	17	31	21	45	14	40	26	42	29	37	31	45	31	45	36	...	...	...	...	...	...	26.5	12.9
Eastern Plateau:																																
Binghamton	26	18	22	10	18	9	26	10	29	14	34	16	33	9	44	17	44	34	45	33	51	29	50	42	...	...	...	...	...	...	28.3	14.1
Bouckville	26	18	23	14	18	8	27	9	31	8	34	22	33	6	42	21	41	20	42	34	47	25	53	37	...	...	...	...	...	...	27.6	12.4
Cooperstown	24	16	22	13	18	6	26	12	25	5	33	13	32	-1	44	15	44	28	41	34	46	30	46	34	...	...	...	...	...	...	26.5	10.8
Griffins Corners	29	19	22	13	20	6	39	3	32	7	30	24	48	-1	52	10	45	26	42	32	57	31	47	39	...	...	...	...	...	...	31.2	10.7
Meredith	22	15	19	10	12	4	21	8	29	12	30	21	32	10	38	18	40	26	38	30	47	31	45	36	...	...	...	...	...	...	24.1	11.3
Mohonk Lake	33	19	25	18	28	9	31	11	26	15	27	19	36	14	38	19	37	29	42	28	48	30	46	35	...	...	...	...	...	...	29.8	14.8
Oneonta	27	19	23	13	22	10	32	11	28	5	12	19	40	-3	46	12	47	30	42	34	57	31	55	37	...	...	...	...	...	...	31.2	12.9
Oxford	29	15	25	13	20	8	28	3	30	3	35	-3	37	12	44	9	46	27	45	34	48	27	51	35	...	...	...	...	...	...	30.0	11.0
Perry City (near)	24	14	21	13	18	5	28	-1	35	7	34	20	38	1	47	20	37	27	42	30	48	24	49	35	...	...	...	...	...	...	29.1	10.4
Port Jervis	32	25	26	18	26	10	38	12	36	16	32	27	46	7	47	9	39	27	47	36	55	32	45	36	...	...	...	...	...	...	33.1	15.9
Richmondville	26	16	27	13	19	7	28	12	24	8	35	18	37	7	47	15	41	23	46	29	46	32	55	32	...	...	...	...	...	...	29.3	12.0
South Kortright	29	20	23	14	19	7	32	10	31	3	30	21	40	-10	44	1	45	27	40	32	53	33	48	37	...	...	...	...	...	...	29.2	10.4
Straits Corners	23	10	22	13	18	5	28	0	29	10	33	18	43	-2	43	14	42	27	38	32	45	25	45	35	...	...	...	...	...	...	28.6	9.6
Walton	27	21	24	15	17	10	31	10	31	8	32	17	39	-6	43	6	46	26	43	35	51	33	50	45	...	...	...	...	...	...	29.1	12.4
Waverly	28	20	25	16	25	8	31	1	31	15	36	16	42	2	48	10	45	30	44	34	49	24	49	38	...	...	...	...	...	...	31.8	13.0
Windham	28	19	25	12	15	6	32	9	32	1	32	22	39	-10	52	1	54	25	42	33	50	33	50	33	...	...	...	...	...	...	29.6	10.4
Northern Plateau:																																
Adirondack Lodge	25	14	19	9	14	0	27	10	30	0	33	0	39	0	40	17	42	31	45	26	50	24	49	34	...	...	...	...	...	...	25.1	4.8
Axton	24	12	20	11	14	-2	28	-23	34	-8	36	-6	42	-11	45	10	45	21	50	22	56	11	52	31	...	...	...	...	...	...	28.7	0.9
Gabriels	23	11	17	10	11	3	28	-3	34	3	35	14	44	4	44	20	42	27	47	23	51	25	52	33	...	...	...	...	...	...	27.1	6.8

MAXIMUM AND MINIMUM TEMPERATURES FOR NEW YORK, FEBRUARY, 1902—(*Concluded*).

STATIONS.	17.		18.		19.		20.		21.		22.		23.		24.		25.		26.		27.		28.		29.		30.		31.		MONTHLY MEAN.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Northern Plateau—(Continued):																																
Gloversville	27	14	27	11	20	8	28	8	28	2	38	16	33	1	40	12	40	13	48	34	45	25	44	34							28.0	9.6
Keene Valley	29	15	25	14	19	6	41	3	33	1	35	−2	40	−6	48	13	44	28	49	36	52	22	52	29							31.6	6.8
Little Falls 2	26	19	25	15	18	3	23	−4	28	11	41	15	37	8	43	12	43	28	51	39	53	24	43	35							28.9	10.2
Number Four	26	15	18	12	13	3	24	−11	35	4	41	11	39	6	39	26	46	29	50	31	53	23	49	40							26.8	7.7
Saranac Lake	24	12	19	10	15	4	30	1	36	−2	36	11	47	−3	47	12	49	18	49	24	53	20	54	34							29.2	5.8
South Schroon	25	12	24	15	20	5	37	7	32	5	36	17	40	5	42	14	45	29	49	32	52	26	50	32							30.0	9.3
Wells	25	10	26	18	28	7	40	−6	32	−3	43	22	45	−6	47	10	49	26	51	33	55	23	47	30							32.8	5.6
West Chazy	23	5	27	19	21	3	27	2	32	2	30	14	27	0	42	11	45	25	44	22	44	22	45	30							27.8	8.2
Atlantic Coast:																																
Bedford	32	18	23	18	22	10	32	13	30	15	33	20	40	18	40	12	42	27	43	36	54	35	49	35							32.4	18.4
Catchogue	35	25	32	21	30	16	35	19	32	16	35	28	39	22	43	12	39	28	40	31	50	32	41	33							35.4	21.3
New York City	32	25	29	22	29	15	32	17	32	25	35	30	38	25	42	29	40	36	47	40	52	39	54	43							33.6	23.4
Primrose	31	25	34	24	31	13	38	12	33	14	37	28	41	18	42	15	42	27	44	38	46	30	52	34							35.0	19.4
Setauket	31	27	30	21	29	15	31	18	31	19	34	28	36	25	41	21	37	32	41	34	53	34	54	34							33.9	22.6
Southampton	31	31	36	25	28	14	31	19	31	18	34	31	34	23	38	20	39	31	42	36	48	36	42	33							34.5	21.6
Hudson Valley:																																
Albany	26	22	25	19	22	12	23	14	26	8	36	22	33	8	42	10	43	31	45	35	49	31	48	34							30.6	16.6
Canaan Four Corners	29	20	26	15	18	7	27	9	32	9	31	20	36	7	40	9	40	30	45	34	51	29	45	38							28.0	13.4
Carmel	28	21	26	17	27	5	28	10	32	16	32	30	35	15	45	3	45	28	42	38	54	35	43	38							31.8	16.9
Catskill	29	23	31	21	28	15	37	17	27	13	35	25	36	13	42	11	42	29	44	35	50	33	47	35							32.3	18.0
Cedar Hill	36	22	27	19	24	12	38	15	26	9	32	24	38	5	47	10	45	29	43	34	52	30	48	32							32.1	15.6
Greenwich	29	19	29	21	23	10	27	4	28	4	31	23	34	4	42	12	42	29	43	31	45	38	54	43							30.0	14.3
Honeymead Brook	26	24	26	16	26	10	31	13	29	9	32	24	34	12	45	9	45	30	42	34	52	30	49	35							32.0	16.7
Wappingers Falls	30	22	35	20	34	20	32	−6	27	7	32	25	35	−3	44	−2	43	25	46	35	52	27	49	33							33.0	14.8
Mohawk Valley:																																
Canajoharie	26	14	24	17	19	8	33	8	27	6	42	23	46	2	44	12	45	24	52	34	54	28	41	32							32.1	11.9
Little Falls 1	26	16	20	14	17	6	26	6	24	6	39	22	33	14	38	18	38	28	46	28	42	28	54	36							26.6	12.0
Rome	30	17	25	18	21	10	27	7	29	8	36	22	33	7	43	23	42	32	41	33	44	29	44	36							28.0	14.1
Champlain Valley:																																
Caldwell	27	15	30	19	29	11	28	−2	27	2	37	21	30	4	38	13	44	31	47	33	46	27	49	31							30.0	10.2
arvers Falls	24	20	20	19	23	0	22	−9	22	0	22	17	17	−3	36	13	42	29	35	29	42	23	52	28							25.9	8.3
lens Falls	26	18	33	22	30	11	31	4	32	8	38	25	34	10	41	15	45	30	44	35	46	28	50	33							31.5	14.0

Plattsburg	23	6	28	18	27	8	29	10	30	2	30	5	34	3	40	12	42	28	42	22	44	21	48	27	...	...	...	...	...	...	29.0	8.1
Saratoga Springs	28	19	30	22	30	11	34	4	31	4	39	25	36	5	42	14	43	29	47	35	47	28	51	32	...	...	...	...	...	...	31.9	12.8
Ticonderoga	24	17	40	20	32	11	38	-5	28	5	35	13	33	2	43	15	44	33	44	30	47	25	54	30	...	...	...	...	...	...	33.1	11.7
St. Lawrence Valley:																																
Canton	22	2	22	11	17	2	28	1	30	5	26	1	30	-6	40	9	35	22	21	20	54	20	55	20	...	...	...	...	...	...	25.6	4.6
Moira	20	6	22	6	18	3	27	7	31	8	27	8	31	1	35	14	39	26	35	24	44	26	59	30	...	...	...	...	...	...	25.7	7.9
Ogdensburg	27	10	25	13	19	4	28	0	32	10	33	12	34	10	40	20	38	24	38	25	50	20	55	33	...	...	...	...	...	...	29.2	10.7
Watertown	25	17	23	8	17	2	31	9	37	8	30	4	34	23	44	26	43	23	39	22	48	21	50	34	...	...	...	...	...	...	28.9	12.1
Great Lakes:																																
Appleton	29	13	27	14	23	12	29	7	32	9	34	19	42	9	40	29	36	24	37	27	46	21	52	35	...	...	...	...	...	...	30.1	14.9
Baldwinsville	28	9	23	16	22	13	28	9	33	9	37	14	37	12	47	22	43	31	40	31	44	26	44	35	...	...	...	...	...	...	29.4	14.5
Brockport	25	11	23	12	18	9	28	9	32	9	33	15	40	12	40	28	40	29	37	29	45	24	50	35	...	...	...	...	...	...	27.4	13.2
Buffalo	25	18	23	8	20	5	28	10	36	22	34	20	40	20	42	36	39	30	46	24	50	35	57	44	...	...	...	...	...	...	28.1	16.3
Oswego	26	18	26	16	23	12	27	15	33	14	30	19	35	12	43	27	42	32	34	28	44	25	46	39	...	...	...	...	...	...	28.4	16.6
Ridgeway	26	13	26	12	21	11	29	6	30	8	29	9	41	11	42	30	36	26	37	25	43	19	49	37	...	...	...	...	...	...	28.2	13.4
Rochester	27	17	26	12	20	8	28	10	33	20	33	24	42	16	40	34	39	32	35	29	52	32	55	41	...	...	...	...	...	...	28.6	16.1
Volusia	20	12	20	12	15	3	31	0	37	20	30	12	41	16	42	32	39	30	55	31	46	30	50	39	...	...	...	...	...	...	36.9	12.3
Westfield 2	22	14	19	12	16	14	27	2	36	18	31	18	43	17	41	32	42	30	44	31	47	32	53	42	...	...	...	...	...	...	26.6	14.2
Westfield 3	26	18	22	12	19	7	31	3	34	17	32	19	44	14	41	33	34	30	33	24	48	26	47	46	...	...	...	...	...	...	27.0	14.6
Central Lakes:																																
Auburn	28	16	23	14	21	9	30	10	35	15	39	22	41	9	45	30	46	32	40	30	54	23	51	41	...	...	...	...	...	...	30.4	14.5
Fayetteville	30	15	22	15	22	15	32	8	34	12	42	18	40	8	41	24	42	32	46	34	50	24	52	35	...	...	...	...	...	...	30.8	13.8
Ithaca	26	19	22	10	20	9	30	10	31	16	33	19	44	11	46	12	46	33	36	30	50	28	50	44	...	...	...	...	...	...	28.6	14.3
Penn Yan	24	18	23	12	19	9	30	7	30	15	36	24	42	11	46	28	40	32	43	35	51	30	53	40	...	...	...	...	...	...	29.3	14.8
Romulus	27	17	24	12	18	9	30	9	30	9	35	10	38	16	43	27	42	31	39	2[illegible]	49	29	50	38	...	...	...	...	...	...	29.2	14.6

DAILY PRECIPITATION FOR NEW YORK, FEBRUARY, 1902.

STATIONS.	DAY OF MONTH.															
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
Western Plateau:																
Addison	.04	.50	.01	.....	.....	.....	.01	T.	.....	T.	.....	.01	.02	.....	.....	.....
Akron	.....	.43	.21	.06	.03	T.	.08	.14	.16	.03	.11	.20	T.	T.	.02	.....
Alden	T.	.55	.35	.05	.05	.....	.10	.12	.02	.....	.20	.28	.30	T.	.....	.....
Angelica	.05	.50	T.	T.	T.	T.	.05	.05	T.	T.	T.	.10	.20	.....	.....	.....
Atlanta	.05	.78	.10	.06	.....	.....	.05	.....	.21	.02	.....	.04	.07	.....	.....	.....
Avon	.25	.47	.10	.....	.....	.....	.....	T.	T.	.20	.....	.10	.10	.....	.....	.....
Bolivar	.08	.50	.35	T.	.....	T.	.09	T.	.10	T.	T.	T.	.04	.....	.....	.....
Elba	.....	.40	.20	.10	.....	.....	.....	.60	.....	.....	.....	.20	.60	T.	.....	.....
Franklinville	T.	.40	.17	.08	.....	T.	.11	.50	.21	T.	T.	.06	.03	T.	T.	T.
Hemlock Lake	.....	.55	.....	.....	.....	.....	T.	.70	.....	.....	.....	T.	.30	T.	.....	.....
Humphrey	.....	.95	.17	.03	.....	.....	.08	.04	.09	.....	.....	.36	.....	.....	.....	.....
Jamestown	.07	.70	.04	.04	.....	T	.08	.10	.10	.09	T.	.05	.02	.....	.....	.....
Nunda	T.	1.30	.....	.....	.....	.....	.....	T.	T.	.....	.....	T.	.30	.....	.....	.....
Shortsville	.....	.60	.20	.....	.....	.....	.20	.....	.....	.....	.....	.....	.....	.....	.....	.....
South Canisteo	T.	.60	.....	T.	.....	.....	.10	.10	T.	.....	.....	.20	T.	.....	.....	.....
Wedgewood	T.	.49	.05	T.	.....	.....	.05	.10	T.	T.	.....	.07	.15	.....	.....	.....
Eastern Plateau:																
Binghamton	.09	.54	.08	.01	.01	.....	.02	.03	T.	.01	.....	.01	.01	T.	.....	.....
Bouckville	.05	.70	.90	.05	.....	.....	.10	.30	.50	.10	.05	.....	.10	.....	.....	.....
Cooperstown	.08	.90	.....	.....	.....	.....	.02	.38	.....	.....	.....	.12	.....	.....	.....	.....
Cortland	.04	.02	.46	.02	.....	.....	.02	.25	.10	.08	.....	.02	.....	.02	.....	.....
Griffins Corners	*	.52	.03	.....	.....	.....	.....	.....	.....	.....	.....	.....	.05	.....	.....	.....
Meredith	.17	.86	T.	T.	.10	.....	.....	.....	.....	T.	.....	T.	.12	T.	.....	.....
Middletown	.07	.61	.....	T.	.....	.....	T.	.....	.....	T.	.....	.....	.....	.....	.....	.....
Mohonk Lake	.06	.97	.....	.02	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	*
Newark Valley	.01	.65	.....	.....	.....	.....	.05	T.	T.	.02	.....	T.	T.	.....	.....	.....
New Lisbon	T.	.89	.....	.....	.....	.....	.....	T.	.....	.08	.....	.....	.....	.....	.....	.....
Oneonta	.....	1.06	.11	.....	.....	.....	T.	.08	.....	.....	.....	T.	.....	.....	.....	.....
Oxford	.30	.90	.45	.05	T.	.....	.10	.10	.15	.05	.....	.05	.10	.....	.....	.....
Perry City (near)	.03	.43	.....	T.	.10	.....	.06	T.	.....	T.	.....	.09	.06	T.	.....	.....
Port Jervis	T.	.62	.....	.03	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Richmondville	T.	.25	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.	.20	.....	.....	.....
Salisbury Mills	.40	.80	.16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
South Kortright	.04	.71	.63	.04	.....	.....	.02	.07	.03	T.	.....	.....	T.	T.	.....	.....
Straits Corners	.10	.20	T.	.....	.....	.....	.15	T.	.....	.....	.....	.10	.10	.....	.....	.....

Walton	.04	.61	.20	T.			.10	.10	.10			.05				
Waverly	.05	.39		.01			.04	T.	T.			.01	T.	.02	T.	
West Berne	.05	.20	.35	T.					.30							
Windham	.04	.30		.01					.07		T.		.06	T.		
Northern Plateau:																
Adirondack Lodge	.10	1.20					.31	.25	.53	.44		T.	T.	.22		
Axton	.04	.80	1.31	T.			.10	T.	.80	T.	T.	.06		T.		
Gabriels	.20	1.00	.15	.15			.05	.10	.50	.15		.10		.0		
Gloversville	.24	1.03	.42	T.			T.	T.	T.		T.	T.				
Keene Valley	.08	1.35	.24	T.	T.	T.	.03	.10	.10	T.		T.	.03	T.		
Little Falls 2		1.72	.30					.10	.40							
North Lake	T.	.49	1.50	1.30	.17		T.				T.	.10				
Number Four	.10	.80	.60		.10		.20	.90	.70		.15			.15		
Saranac Lake	.06	1.05	.40	.03	.01		.07	.13	.47	.05		.05	.01	.03		
South Schroon	.12	1.24	.58	T.	T.		T.	T.	.08							
Wells	.12	1.00	.20					T.								
Atlantic Coast:																
Bedford	T.	.55		.04			T.									
Cutchogue	.05	.56		T.												
New York City	.19	.54		.03			T.					T.				
Primrose	.08	.62		T.												
Setauket	.20	.50	T.	T.												
Southampton	.20	.30	T.	T.												
Hudson Valley:																
Albany	.12	.74	.01	T.	T.		T.	.02	T.	T.	T.	T.	T.			
Athens	.12	.98		T.	T.		T.	T.	T.				T.			
Canaan Four Corners		.41				T.	.08									
Carmel	.15	.69		T.												
Catskill	1.80			T.									T.			
Cedar Hill	.10	.74		T.			T.	T.					T.			
Greenwich	T.	.57	.15	T.				T.	T.							
Honeymead Brook	.19	.34	.39	T.	T.								T.			
Old Chatham	.10	.67	.10					.05	.05				.02			
Red Hook	*	1.13		T.												
Spier Falls	1.00		T.				T.	T.								
Wappingers Falls	.20	1.02		T.				T.								
Mohawk Valley:																
Canajoharie	T.	.22		T.			.02		T.		T.	T.	T.	T.		T.
Little Falls 1		.60	.70	T.			.04	.32		.18						
Rome		*	2.05	.30				.20	.30							
Champlain Valley:																
Caldwell	.15	1.18	T.	T.			T.	T.								
Glens Falls	.10	.69	.14													
Plattsburg	.20	.40	.80													

T.—Trace, when precipitation is less than 0.01 inch. *Amount included in next measurement.

DAILY PRECIPITATION FOR NEW YORK, FEBRUARY, 1902—(*Continued*).

STATIONS.	DAY OF MONTH.															
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
Champlain Valley—(Continued):																
Saratoga Springs	.....	.92	T.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ticonderoga	.10	.88	.44	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
St. Lawrence Valley:																
De Kalb Junction	.20	.40	.30	T.	.....	.....	.05	.13	.69	.....	.05	.08	.02	T.	.....	.....
Moira	.20	.60	.30	.....	.....	.....	.10	.40	.40	.....	.....	T.	.....	.....	.....	.....
North Hammond	.08	.40	.30	.20	T.	.02	.20	.02	.40	.....	.10	T.	.....	.....	.....	.....
Ogdensburg	.04	.24	.20	.....	.....	.....	.04	.02	.10	.....	T.	.10	.....	.....	.....	.....
Watertown	T.	.78	.43	.18	.18	.02	.38	.18	.12	.....	.05	.10	.....	.....	.....	.....
Great Lakes:																
Adams Center	.12	1.10	.86	.86	.96	.12	.18	.38	.12	.06	.15	.48	.24	.12	.06	.06
Appleton	.....	.24	.01	.....	.....	.....	.07	.05	.02	.....	.....	.05	.....	.....	.....	.....
Baldwinsville	.....	.80	.60	.....	.....	.....	.02	.60	.50	.30	.....	T.	T.	T.	.....	.....
Brockport	.....	.31	.10	.....	.....	.....	.10	.50	.....	.....	.....	.....	.20	T.	.....	.....
Buffalo	.02	.40	.10	.22	.28	.02	.17	.14	.14	T.	.01	.03	.50	.02	T.	T.
Lyndonville	.....	.08	.40	.16	.....	.....	.10	.12	.18	.....	.....	.....	.....	.....	.....	.....
Lyons	.....	.80	.40	T.	.....	.....	T.	.30	.30	.....	.....	T.	.....	.....	.....	.....
Mayle	.30	.18	.....	.....	.....	.....	.....	.19	.....	.....	.....	.....	.27	.54	.....	.....
Oswego	.02	.75	.03	.03	T.	.....	.03	.07	.09	.01	.21	.10	.02	T.	.....	T.
Palermo	.....	*	.60	.....	.01	.....	.03	.60	.25	.03	.01	T.	.02	.....	.....	.....
Ridgeway	T.	.80	.25	T.	.....	T.	.12	.63	.05	.10	T.	.21	T.	T.	.....	.....
Rochester	T.	.80	.34	T.	T.	.....	.06	.38	.13	.20	T.	.03	.24	.01	.....	.....
Volusia	T.	.41	.30	.17	.....	T.	.61	.40	.65	.06	.07	.15	.04	.....	.....	.....
Westfield 2	.....	.37	.10	.09	.....	T	.18	.12	.06	T.	.02	.06	T.	.....	.....	.....
Westfield 3	T.	.19	.01	T.	.....	.05	.05	.01	.02	T.	T.	.02	.02	.....	T.	T.
Walcott	T.	.90	.30	.....	.....	.....	T.	.30	.20	T.	.....	.05	.10	.....	.....	.....
Central Lakes:																
Auburn	.....	.94	.23	.....	.....	.....	.03	.28	.10	.06	.....	.....	.06	.....	.....	.....
Fayetteville	.09	.46	.49	.....	.....	.....	T.	.76	.52	.02	.....	T.	.....	.04	.....	.....
Ithaca	T.	.28	.03	T.	.03	.....	.01	T.	.03	T.	.....	.03	.04	.01	T.	.....
King Ferry	.03	.59	.....	.05	.....	.....	.05	.....	.08	.....	.....	.04	.03	T.	.....	.....
Penn Yan	T.	.50	T.	T.	.....	.....	T.	T.	T.	T.	.....	.01	.01	T.	.....	.....
Skaneateles	.04	.55	.40	.....	.....	.....	.05	.47	.07	.03	.04	.12	.03	.03	T.	.....

T.—Trace, when precipitation is less than 0.01 inch. *Amount included in next measurement.

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DAILY PRECIPITATION FOR NEW YORK, FEBRUARY, 1902—(*Continued*).

STATIONS.	DAY OF MONTH.															Total.
	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	
Western Plateau:																
Addison	.....	T.	.03	.....	.24	.....	.....	.....	T.	T.	.....	.56	.....	.....	.....	1.42
Akron	.....	.....	.....	.....	.....	.....	.....	.07	T.	.....	.....	.17	.....	.....	.....	1.71
Alden	.....	.04	.02	.....	.....	.....	.....	.03	.....	.....	.....	.07	.....	.....	.....	2.18
Angelica	T.	T.	.20	.....	.10	.....	.....	.....	.....	.....	.....	.55	.....	.....	.....	1.80
Atlanta	.....	.12	.....	.....	.11	.....	.....	.....	.....	.....	.....	.33	.....	.....	.....	1.94
Avon	.....	T.	.....	.....	.....	.....	.....	.....	.....	.....	T.	T.	.....	.....	.....	1.22
Bolivar	T.	.03	T.	.....	.06	.....	.....	.....	.....	T.	.....	.74	.....	.....	.....	1.99
Elba	.....	T.	.....	.....	.....	.....	.....	T.	.....	.....	.....	.50	.....	.....	.....	2.60
Franklinville	T.	.06	.....	.....	.03	.....	.....	T.	.....	.....	.....	.80	.....	.....	.....	2.45
Hemlock Lake	.....	.30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.30	.....	.....	.....	2.15
Humphrey	.04	.18	.....	.....	.05	.....	.....	.....	.....	.....	.....	1.54	.....	.....	.....	3.53
Jamestown	T.	.05	T.	.....	.....	.....	.....	T.	.....	.....	.....	.55	.....	.....	.....	1.89
Nunda	.....	T.	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.	.....	.....	.....	1.60
Shortsville	.....	.....	.20	.....	.....	.....	.....	.....	.....	.....	.....	.15	.....	.....	.....	1.35
South Canisteo	T.	.10	.....	.....	.10	.....	.....	T.	.....	.....	T.	1.17	.....	.....	.....	2.37
Wedgewood	.10	.10	.05	.....	.20	T.	.....	.....	.....	T.	.....	66	.....	.....	.....	2.02
Eastern Plateau:																
Binghamton	.14	.12	T.	T.	.27	.22	.....	.....	T.	.13	.....	.62	.....	.....	.....	2.31
Bouckville	.20	1.00	.25	.....	10	.....	.....	.....	.....	.....	.....	21	.....	.....	.....	4.61
Cooperstown	90	.07	.....	.....	.12	.....	.....	.....	.05	.....	.....	.25	.....	.....	.....	2.89
Cortland	.02	.03	.....	.....	.07	.....	.....	.....	.....	.....	.....	.20	.....	.....	.....	1.35
Griffins Corners	*	.49	.....	.....	*	.56	.....	.....	.....	.....	.....	.88	.....	.....	.....	2.53
Meredith	64	T.	.....	.....	.24	.19	.....	.....	T.	.29	.07	.36	.....	.....	.....	3.04
Middletown	.95	T.	.....	.....	.60	1.50	.....	.....	.28	.....	.....	.90	.....	.....	.....	4.91
Mohonk Lake	*	1.02	.....	.....	*	1.60	.....	.....	.08	.25	.....	.32	.....	.....	.....	4.32
Newark Valley	.05	T.	.....	.....	.35	.16	.....	.....	.....	.....	.....	.75	.....	.....	.....	2.04
New Lisbon	.70	.18	.01	.....	.20	.....	.....	.....	.....	.....	.....	.75	.....	.....	.....	2.81
Oneonta	.62	.14	.....	.....	.28	.....	.....	.....	.....	.14	.....	.54	.....	.....	.....	2.97
Oxford	.60	.35	T.	.....	.20	.05	.....	.....	T.	T	.....	.57	.....	.....	.....	4.02
Perry City (near)	.....	.11	.....	.....	.13	.....	.....	.....	.....	T.	.....	.45	.....	.....	.....	1.46
Port Jervis	.85	.....	.....	.....	.65	2.09	.....	.....	.31	.35	.....	1.56	.....	.....	.....	6.46
Richmondville	1.63	.15	.....	.....	.10	.03	.....	.....	.05	.....	.....	.70	.....	.....	.....	3.11
Salisbury Mills	.22	.46	.....	.....	.35	3.50	.....	.....	.25	.90	.....	1.20	.....	.....	.....	8.24
South Kortright	.62	.17	T.	T.	.16	.09	.....	.....	.....	.21	.04	.73	.....	.....	.....	3.56
Straits Corners	.20	.....	.....	.....	.20	.20	.....	.....	.02	.08	T.	.85	.....	.....	.....	2.20

T.—Trace when precipitation is less than 0.01 inch. *Amount included in next measurement.

DAILY PRECIPITATION FOR NEW YORK, FEBRUARY, 1902—(*Continued*).

STATIONS.	DAY OF MONTH.															Total.
	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	
Eastern Plateau—(Continued):																
Walton	2.70	.20		.05	.35	.35				.11		.80				5.76
Waverly	.08	.05	T		.55	.32			.03	.05	.03	.77				2.20
West Berne	*	2.00			*	.30			T.	T.		2.40				5.60
Windham	1.40	.20			.17	.47				.10	.02	.91				3.88
Northern Plateau																
Adirondack Lodge	*	1.21	.10									.25				4.61
Axton	T.		.36	T.				T.		.04		T.				3.45
Gabriels	.05	.35		T.						T.		.05				2.87
Gloversville	1.06	.04	T.		.04	T.				T.		.30				3.13
Keene Valley	.45	.60	T.							T.		.52				3.50
Little Falls 2	.15	.40										.25				3.32
North Lake		.59	.40													4.55
Number Four	.15	1.20	.30									.36				5.81
Saranac Lake	.24	.24	.07	T.				T.		T.		T.				2.91
South Schroon	.41	.30								.02		.12				2.87
Wells	.50	.20						T.		T.		T.				2.02
Atlantic Coast:																
Bedford	1.80	T.			.62	1.31			.03	.13		1.47				5.95
Cutchogue	1.10	.10			.40	1.40	.10		.10	1.25		.75				5.81
New York City		T.			1.02	1.47	.01		.19	.98		.42				5.78
Primrose	1.18				.98	.78			.22	1.12		1.10				6.38
Setauket	.75				1.12	1.21			.20	.63		.86				5.47
Southampton	2.40	.10			.10	1.60	.10		T.	.50	.10	T.				5.40
Hudson Valley:																
Albany	.66	.29			.06	.07				.09	T.	.98				3.04
Athens	1.40	T.			.21	.48			T.	.31		1.02				4.52
Canaan Four Corners	.59	.23			.10					.30		.50				2.21
Carmel	.87				*	1.88				.26		1.28				5.13
Catskill	1.00					.90				.94		.24				4.88
Cedar Hill	.30	T.			.06	.15			T.	.22		1.14				2.71
Greenwich	*	.52			T.					.04		.12				1.40
Honeymead Brook	.40	.40			.45	.35			.14	.06		.82				3.54
Old Chatham	1.80	.20			.30					*	1.35					4.64
Red Hook	1.33				1.14				.32							3.92

Spier Falls	.17									.12		1.03				2.32
Wappingers Falls	.95	.05	T.		.65	1.22			.32	.42		.10				4.93
Mohawk Valley.																
Canajoharie	1.97	.08	T.		.09					.03		.43				2.84
Little Falls	.52	.12			.06							.45				2.99
Rome	.10	.38										.50				3.83
Champlain Valley:																
Caldwell	.65	T.	T.		T.					.20		.60				2.78
Glens Falls	.20	.10								.18		.62				2.03
Plattsburg	T.	.20														1.60
Saratoga Springs	.82	.15					T.			.63		1.34				3.86
Ticonderoga	.20	.13										.30				2.05
St. Lawrence Valley:																
De Kalb Junction		.12	.09					.02				.02				2.17
Moira	T.	.60	.20					T.				T.				3.08
North Hammond	.20							.22				.06				2.20
Ogdensburg		.07	.05					.03				.07				0.96
Watertown		.18	.08					T.				.02				2.70
Great Lakes:																
Adams Center	.06	.46	.05	.03				.19				.78				7.44
Appleton								T.				.39				0.83
Baldwinsville		.20	.10								.08	.49				3.69
Brockport			.10					T.				.15				1.46
Buffalo	T.	.02	T.			T.		.06	T.	T.		.20				2.33
Lyndonville			T.	.01								.34				1.39
Lyons	.05	.40						.03				.21				2.49
Mayle		.07									.13	.31				1.99
Oswego	T.	.01	.01					T.				.38				1.78
Palermo		.05	.02	.01				T.				.30				1 93
Ridgeway		T.	.12					.04				.30				2.62
Rochester		T.	.11					T.				.21				2.51
Velusia	T.	.05	T.					T.				.26				3.17
Westfield 2	.03	.06	.02					.02				.31				1.44
Westfield 3	T.	T.	T.					.14				.22				0.73
Walcott			.05									.70				2.60
Central Lakes:																
Auburn		.15	.16		T.							.06				2.07
Fayetteville	.12	.29	.18									.29				3.26
Ithaca	.03	.05	T.	T.	.16					.04		.66				1.41
Kings Ferry	T.	.43	.19		.08					T.		.42				1.99
Penn Yan	T.	T.	T		T.							.26				0.78
Skaneateles	.12	.18	.10	.02	T.	T.					.05	.14				2.44

T.—Trace, when precipitation is less than 0.01 inch. *Amount included in next measurement.

Exhibit No. 12.

Report for March, 1902.

WEATHER AND CROPS.

March was a mild month, and snow had disappeared by the 15th. Wheat, rye, grasses and fruit trees were reported in good condition. The season at the close of March was about 10 days in advance of the average, and the conditions were favorable for maple sugar interests. Some plowing for potatoes and oats, and some gardening were done during the latter part of March.

TEMPERATURE.

March was very warm for the season, the mean temperature for the State, as determined from the records of 95 stations, being 37.9°, or 7.8° above the March normal. A cold winter prevailed in this State until the latter part of February, the temperature departure from November 1st to February 28th being 10.3° below the average winter temperatures for that period, but the warm weather of March has largely offset this deficiency, the temperature departure from November 1st to March 31st being 2.5° below the normal. The maximum for the month was 71° at Fayetteville on the 29th, and the minimum was —2° at Axton on the 5th. The highest local monthly mean was 44.0°, and the lowest local mean was 32.0° at Adirondack Lodge. The mean temperature ranged from 32° to about 36° or 37° in the Adirondack region, 33° to 37° in the Catskill, about 42° on Long Island, about 40° in the Hudson Valley, and 36° to 39° in other sections. The first two days of the month were

warm, followed by a colder period from the 3d to the 9th. Warmer weather obtained from the 10th to the 13th, followed by a decidedly colder period from the 14th to the 20th, after which it was moderately warm until the end of month.

The mean temperature for each March in New York during the last 14 years is given in the following table:

1889	33.3
1890	29.4
1891	30.3
1892	26.3
1893	29.5
1894	37.8
1895	27.2
1896	24.8
1897	32.9
1898	40.0
1899	30.1
1900	25.2
1901	30.7
1902	37.9

It will be seen from the foregoing table that, with one exception, March, 1898, when the temperature for the State averaged 40.0°, the last month was the warmest March in 14 years in New York State.

PRECIPITATION.

The average precipitation, as determined from reports of 114 stations, well distributed throughout New York State, was 3.62 inches, or 0.24 inch above the normal. The largest monthly total at any one station was 9.40 inches at Adirondack Lodge, and the least was 0.90 inch at Lyndonville. While the average for the State, as a whole, was about normal, the precipitation in the northern and eastern sections was heavy, 6 inches or more being reported from several stations in those sections,

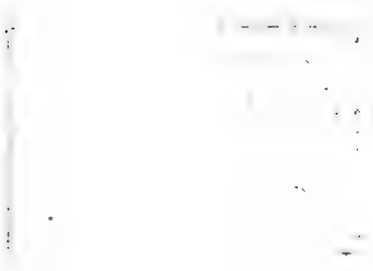
while the amounts reported in the western portion were light, the total monthly amounts decreasing toward the west and parts of Chautauqua reporting but about 1 inch, as compared with about 2 inches at Penn Yan, about 4 inches at Oxford and 6 inches at Mohonk Lake. Heavy rains occurred in parts of the State on the 1st and 2d. Very little precipitation occurred on the 4th, 7th, 10th, 11th, 14th, 15th, 22d, 23d, 24th, 25th and 26th. More or less precipitation occurred on other dates.

The average precipitation for each March during the last 14 years is given in the following table:

1889	1.74
1890	3.72
1891	3.30
1892	3.16
1893	2.43
1894	1.72
1895	1.61
1896	4.92
1897	3.40
1898	2.14
1899	4.67
1900	4.08
1901	3.52
1902	3.62

SNOWFALL.

Several inches of snow fell in central and western New York during the first week of March, and light snows, at intervals, in places from the 13th to the 20th. Heavy snows were general in eastern New York on the 5th and 6th, and greatly hindered railway traffic. Among the larger amounts reported at that time (5th and 6th) were 11 inches at Saratoga, 15 inches at West Berne, 13 inches at Windham, 9 inches at Cutchogue, 8 inches at Primrose, 8 inches at Carmel, 8 inches at Catskill, 10



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inches at Wappingers Falls and 11 inches at Catskill. The total snow for the month was 17 inches at Gloversville, 13 at Adirondack Lodge, 13 at South Kortright, 13 at Bouckville and 22 at Canajoharie. The month was so warm, however, that all snow melted quickly, and the ground was bare during nearly the entire month.

WINDS.

The prevailing winds were from the northwest, and the total wind movement for the month was decidedly less, probably about 15 to 20 per cent., than that for February with only 28 days. The total movement during the month of March, 1902, at New York, was 13,532 miles, with a maximum velocity of 74 miles from the northwest on the 19th. The total movement at Buffalo was 10,906 miles, with a maximum velocity of 52 miles from the southwest on the 13th. The total wind travel at Ithaca was 6,874 miles, with a maximum velocity of 28 miles from the northwest on the 19th. The average hourly movement was 18.2 miles at New York, 14.7 at Buffalo and 9.2 at Ithaca.

FLOODS.

Owing to the rapid disappearance of snow during the warm weather at the close of February, and to heavy rains on February 28th and on March 1st, disastrous floods occurred on the 1st, 2d and 3d in parts of central and eastern New York. Railway bridges were washed away, and traffic was suspended on several roads on the 1st and 2d, and was only partly resumed at a late hour March 3d. The flood at Owego was thought to equal the flood of 1865, when so much damage was done in that section. Great damage was done to business interests on low lands.

ERRATA.

February, 1902, report.— Ithaca: Precipitation, February 21, page 8, recorded .16, should be .17.

Primrose: Precipitation, February 25, page 8, recorded .22, should be .52.

GENERAL SUMMARY FOR MARCH, 1902.

TEMPERATURE.

	Degrees
Mean temperature (determined from records of 95 stations)	37.9
Departure from normal	+7.8
Highest local monthly mean (at New York city)	44.0
Lowest local monthly mean (at Adirondack Lodge)	32.0
Highest temperature (at Fayetteville, on 29th)	71
Lowest temperature (at Axton, on 5th)	—2

PRECIPITATION.

	Inches.
Average precipitation (determined from records of 114 stations)	3.62
Departure from normal	+0.24
Greatest amount recorded at any station (at Adirondack Lodge)	9.40
Least amount recorded at any station (at Lyndonville)	0.90
Average number of days on which 0.01 inch or more fell	11

WIND.

Prevailing wind direction	NW.

WEATHER.

Average number of clear days	10
Average number of partly cloudy days	8
Average number of cloudy days	13

MISCELLANEOUS PHENOMENA (DATES OF).

Auroras.— 23.

Fogs.— 2, 9, 10, 11, 13, 16, 20, 21, 22, 23.

Hail.— 5, 13, 20, 30, 31.

Sleet.— 13, 19, 20.

Lunar Halos.— 4.

Solar Halos.— 4, 5, 7, 8, 12, 15, 19, 23, 30.

Parhelia.— 4, 6, 11, 12.

Thunderstorms.— On the 1st, at 16 stations; 11th, 1; 12th, 2; 14th, 1; 16th, 2; 17th, 1; 27th, 2; 28th, 1; 30th, 7; 31st, 3.

ATMOSPHERIC PRESSURE, RELATIVE HUMIDITY, AND WIND FOR MARCH, 1902.

STATIONS.	BAROMETER, IN INCHES.					Mean relative humidity, per cent.	WIND.			
	Mean.	Maximum.	Date.	Minimum.	Date.		Total movement, miles.	Maximum velocity, miles.	Direction.	Date.
New York	29.97	30.52	15	29.12	2	69	13,532	74	nw.	19
Albany	29.98	30.51	15	29.16	2	78	7,480	34	se.	29
Binghamton	29.98	30.42	15	29.24	2	.....	6,289	30	n.	19
Rochester	30.00	30.40	14	29.27	29	75	7,284	36	sw.	29
Buffalo	29.98	30.40	14	29.24	29	72	10,906	52	sw.	13
Oswego	29.97	30.44	14	29.26	2	77	9,153	33	n.	13
Erie, Pa	29.97	30.39	13	29.26	29	.....	9,511	37	s.	16
Ithaca	30.02	30.40	15	29.37	29	76	6,874	28	nw.	19

Caldwell.— Robins seen on the 10th.

Saratoga Springs.— Robins seen on the 13th.

North Hammond.— Navigation opened on 22d on St. Lawrence.

Lyons.— Thunderstorms on 27th and 30th.

Palermo.— Robins seen on 5th.

Penn Yan.— Thunderstorm on 28th.

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SUPPLEMENTAL TABLE, MARCH, 1902.

STATIONS.	Total precipitation.	Mean temperature.	Observers.
Adams Center	4.30	.....	A. E. Cooley.
Akron	1.89	.....	H. A. Wilder.
Athens	5.60	.....	E. C. Brooks.
Blue Mountain Lake	4.35	.....	B. F. Merwin.
Boyd's Corners	7.49	.....	Thomas Manning.
De Kalb Junction	3.91	.....	C. A. Hallegas.
Easton	3.08	.....	H. Taber.
Gansevoort	6.28	.....	R. E. Cronkhite.
Haskinville	1.24	.....	Walter G. Collins.
Kings Ferry	3.12	.....	L. A. Goodyear.
Lyndonville	.90	.....	Frank Plummer.
Newark Valley	4.54	.....	M. D. Clinton.
Old Chatham	3.29	.....	Hugh Van Alstyne.
Red Hook	6.36	.....	E. S. Webber.
Salisbury Mills	3.59	.....	H. P. Ramsdell.
Skaneateles	4.13	.....	Edward Conron.
S.E. Reservoir	7.01	.....	Thomas Manning.
Speculator	3.59	.....	Lyman Slack.
Spier Falls	4.53	.....	Geo. E. Evans.
Warwick	3.92	.....	John W. Sly.
Westfield 2	1.48	38.4	John R. Rogers.
Wolcott	3.72	.....	L. W. Lane.

OBSERVERS' REMARKS.

Addison.— Robins on 1st. Floods March 1st.

Angelica.— March unusually warm.

Atlanta.— March ends with a snow storm.

Franklinville.— Many large snow drifts on 8th; robins came on 11th.

Humphrey.— Thunderstorm on 1st; streams overflowing; most severe flood in years.

Wedgewood.—Grains, grasses and fruit trees in good condition.

Griffins Corners.— Blue birds and robins came the 10th.

Meredith.— Bright flash of lightning during the snow flurry on March 31st.

New Lisbon.— Plowing begun; buds had started on hard maple trees by the 15th.

Oneonta.— Thunderstorm and snow flurry in progress at same time March 31st.

Perry City.— Fruit safe at this time.

South Kortright.— Thunderstorm on March 31st.

Adirondack Lodge.— Sugar making began on the 20th.

Axton.— But little snow remains in woods.

Keene Valley.— Ice on east branch of Ausable river broke up on 2d; trees tapped on 10th; good sugar season.

Lowville.— Fields bare during entire month. Large quantity of sugar made.

Number Four.— Thunderstorm on 1st.

South Schroon.— Blue birds and robins seen on the 10th.

Carmel.— Thunderstorm March 1st.

Greenwich.— Robins came on the 10th.

Bangall.— Greatest flood on record.

Wappingers Falls.— Damage by flood $52,000.

Canajoharie.— Great damage by flood on 1st.

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AVERAGE HOURLY WIND MOVEMENT FOR MARCH, 1902.

STATION.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	12 noon.
Albany	9.0	8.8	8.2	8.4	8.4	8.2	7.9	8.9	10.2	11.2	12.5	11.9
Buffalo	13.2	13.0	14.1	14.2	13.7	13.6	14.2	13.7	14.3	14.5	15.1	15.6
Ithaca	7.8	8.1	8.5	8.3	8.2	8.2	8.1	8.0	8.9	9.3	9.6	10.6
New York City	16.4	16.7	17.5	17.5	17.0	16.2	16.7	17.2	17.3	17.8	17.7	17.5
Northfield, Vt.	9.7	10.0	9.5	8.8	8.2	7.5	7.7	7.9	9.5	11.5	12.5	13.5
Oswego	12.3	11.8	12.3	11.7	11.7	11.7	11.4	11.0	12.4	12.5	12.3	12.2
Rochester	9.2	8.6	8.4	8.5	8.2	8.0	8.6	9.0	9.8	10.4	11.1	11.5

PREVAILING HOURLY WIND DIRECTION.

Albany	n.	nw.	nw.	n.	nw.	nw.	n.	nw.	n.	s.	n.	s.
Binghamton	nw.	w.	nw.	n.	nw.	w,nw.	e.	n,w.	w.	nw.	w,nw.	nw.
Buffalo	sw,w.	s.	s,w.	w.	s,w.	s.	s,w.	s,nw.	s,sw.	sw.	sw.	sw.
Ithaca	nw.	nw.	se.	se.	se.	se.	se,nw.	se.	nw.	nw.	nw.	nw.
New York City	*	s,nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.
Rochester	w.	w.	sw,w.	s,w.	s,w.	sw,w.	s,sw.	sw.	s.	ne.	nw.	nw.

*N,SW, NW.

AVERAGE HOURLY WIND MOVEMENT FOR MARCH, 1902—(*Continued*).

STATION.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	12 midnight.	For the month.
Albany	11.7	12.3	12.0	11.5	11.0	10.5	10.0	10.1	10.0	9.7	9.5	9.5	10.1
Buffalo	16.0	16.4	16.4	16.4	15.7	15.2	14.5	14.3	14.6	14.9	14.3	13.8	14.7
Ithaca	11.4	11.4	11.1	10.7	10.3	10.1	9.7	9.7	9.1	8.7	8.6	7.5	9.2
New York City	18.1	19.4	19.7	19.5	20.6	19.7	19.4	18.5	19.2	20.1	19.2	17.5	18.2
Northfield, Vt	13.8	13.5	13.7	12.7	12.5	10.6	9.4	9.1	8.9	10.4	11.6	10.8	10.5
Oswego	13.4	13.5	13.5	12.5	12.3	11.8	11.9	11.8	12.5	12.9	13.3	12.8	12.3
Rochester	12.1	12.4	11.5	11.3	10.5	10.1	9.4	8.7	9.6	9.5	9.8	9.0	9.8

PREVAILING HOURLY WIND DIRECTION—(*Continued*).

Albany	nw.	nw.	nw.	nw.	nw.	nw.	n.	nw.	nw.	nw.	nw.	nw.	nw.
Binghamton	nw.	n,nw.	nw.	n.	nw.	n.	n,nw.	nw.	n,nw.	nw.	n,w.	nw.	nw.
Buffalo	w.	w.	w.	w.	w.	w.	w.	sw.	sw,w.	sw.	sw.	s.	w.
Ithaca	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	n,nw.	nw.	nw.		nw.
New York City	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.
Rochester	‡	nw.	†	w.	w.	nw.	nw.	w.	w.	w.	‡	sw.	w.

†NE, SW, W, NW. ‡SW, W., NW.

CLIMATOLOGICAL DATA FOR NEW YORK, MARCH, 1902.

STATIONS.	Counties.	Elevation, feet.	Length of record, years.	TEMPERATURE, IN DEGREES FAHRENHEIT.						
				Mean.	Departure from the normal.	Highest.	Date.	Lowest.	Date.	Greatest d'ly range.
Western Plateau:										
Addison	Steuben	1,000	12	39.6	+7.1	69	12	9	6	39
Alden	Erie	.....	2	38.2	.....	69	28	9	6	30
Angelica	Allegany	1,340	18	37.7	+8.4	65	27	9	*6	42
Atlanta	Steuben	1,200	11	37.4	.....	63	29	11	*18	38
Avon	Livingston	585	7	38.6	.....	66	12	12	*5	33
Bolivar	Allegany	1,800	6	36.4	.....	64	27	7	18	41
Elba	Genesee	500	2	37.3	.....	62	12	11	19	34
Elmira	Chemung	863	22	40.4	+6.8	68	*12	13	19	33
Franklinville	Cattaraugus	1,598	5	36.3	.....	65	27	7	18	42
Hemlock Lake	Livingston	900	3	37.5	.....	59	*12	14	19	26
Humphrey	Cattaraugus	1,950	18	35.0	+5.9	63	27	5	19	31
Jamestown	Chautauqua	1,328	6	40.2	.....	69	12	8	19	44
Lockport *d*	Niagara	650	16	40.7	.....	66	28	15	19	33
Nunda	Livingston	.....	4	40.4	.....	68	27	12	*18	40
Shortsville	Ontario	740	2	38.7	.....	65	29	15	*18	31
South Canisteo	Steuben	1,480	12	38.0	+7.8	68	29	7	6	40
Wedgewood	Schuyler	1,430	12	36.8	+7.1	64	12	11	*18	28
Eastern Plateau:										
Binghamton	Broome	875	11	38.4	+7.1	67	29	15	18	31
Bouckville	Madison	1,350	4	36.8	.....	65	29	10	*6	33
Cooperstown	Otsego	1,250	48	35.4	+7.9	65	29	12	*5	31
Cortland *a*	Cortland	1,130	41	36.8	+6.7	69	29	10	19	39
Griffins Corners	Delaware	2,260	2	36.4	.....	63	12	5	7	44
Meredith	Delaware	2,260	1	33.6	.....	60	29	8	19	28
Middletown	Orange	700	11	40.4	+7.7	68	29	19	19	24
Mohonk Lake	Ulster	1,245	6	38.3	.....	62	*29	15	19	26
New Lisbon	Otsego	1,234	11	34.6	+6.7	64	29	3	7	40
Oneonta	Otsego	1,100	6	38.5	.....	67	29	12	7	38
Oxford	Chenango	958	38	37.6	+6.7	67	29	8	7	39
Perry City (near)	Schuyler	1,038	12	36.5	+7.8	67	29	9	18	33
Port Jervis	Orange	470	17	41.4	+8.6	70	29	10	7	40
Richmondville	Schoharie	500	3	37.8	.....	67	29	11	*19	34
South Kortright	Delaware	1,441	13	36.6	+7.1	64	*12	1	7	44

Straits Corners *b*	Tioga	600	5	37.0	.....	65	14	8	18	40
Walton	Delaware	.....	1	38.0	.....	65	29	5	7	41
Waverly	Tioga	824	20	39.1	+8.0	70	29	13	7	43
West Berne	Albany	600	3	40.0	.....	69	29	16	11	43
Windham	Greene	1,520	2	36.8	.....	65	12	3	7	44
Northern Plateau:										
Adirondack Lodge	Essex	2,224	.....	32.0	.....	56	29	3	5	28
Axton	Franklin	1,600	2	33.0	.....	62	28	2	5	38
Gabriels	Franklin	1,800	2	33.3	.....	64	28	2	5	33
Gloversville	Fulton	850	10	37.0	.....	57	29	14	7	30
Indian Lake	Hamilton	1,705	2	33.5	.....	57	*28	5	5	41
Jay	Essex	.....	2	37.2	.....	66	28	11	14	43
Keene Valley	Essex	1,000	5	35.8	.....	65	28	10	5	35
Little Falls 2	Herkimer	1,526	5	36.0	.....	60	29	9	7	33
Lowville	Lewis	900	36	35.4	+6.3	61	*28	10	*18	35
North Lake	Herkimer	1,822	5	34.6	.....	61	28	6	19	36
Number Four	Lewis	1,571	13	34.0	+9.3	60	28	6	*5	32
Saranac Lake (near)	Essex	1,750	8	34.8	.....	66	28	3	5	40
South Schroon	Essex	1,225	1	35.8	.....	57	*12	13	*5	32
West Chazy	Clinton	.....	4	36.1	.....	58	28	11	8	28
Atlantic Coast:										
Bedford	Westchester	290	8	41.4	.....	69	*22	13	7	32
Cutchogue	Suffolk	32	3	42.2	.....	64	24	22	7	33
New York City	New York	314	31	44.0	+7.1	65	12	21	19	24
Primrose	Westchester	200	5	42.4	.....	69	21	18	7	35
Setauket	Suffolk	40	16	42.0	+6.0	63	12	23	7	25
Southampton	Suffolk	.....	1	41.0	.....	63	22	21	7	24
Hudson Valley:										
Albany	Albany	97	74	39.6	+7.7	62	29	20	7	25
Canaan Four Corners	Columbia	.....	1	37.6	.....	61	*12	10	6	29
Carmel	Putnam	500	10	40.6	.....	64	*12	10	7	39
Catskill	Greene	450	5	40.2	.....	62	24	18	7	29
Cedar Hill	Albany	208	3	39.6	.....	63	13	16	7	30
Greenwich *c*	Washington	425	4	39.2	.....	61	13	12	19	31
Honeymead Brook	Dutchess	450	21	40.1	+8.5	66	13	11	7	35
Wappingers Falls	Dutchess	110	9	41.3	.....	66	13	11	7	34
Mohawk Valley:										
Canajoharie	Montgomery	300	5	36.6	.....	67	29	7	7	37
Little Falls 1	Herkimer	924	5	36.6	.....	66	29	12	19	30
Rome	Oneida	445	12	38.6	+10.8	66	29	14	19	30
Champlain Valley:										
Caldwell	Warren	350	5	36.8	.....	59	*13	10	7	36
Carvers Falls *a*	Washington	243	4	35.2	.....	63	29	11	7	28
Glens Falls	Warren	340	10	39.4	.....	60	*13	17	7	31

*Also on subsequent dates. *a*, *b*, *c*, etc., indicate number days missing from reports.

CLIMATOLOGICAL DATA FOR NEW YORK, MARCH, 1902—(*Continued*).

STATIONS.	Counties.	Elevation, feet.	Length of record, years.	TEMPERATURE, IN DEGREES FAHRENHEIT.						
				Mean.	Departure from the normal.	Highest.	Date.	Lowest.	Date.	Greatest daily range.
Champlain Valley—(continued):										
Plattsburg	Clinton	125	32	36.9	+10.5	59	29	10	*5	32
Saratoga Springs	Saratoga	314	5	40.0	.....	63	29	20	19	33
Ticonderoga	Essex	128	4	38.6	.....	65	29	11	7	34
St. Lawrence Valley:										
Canton	St. Lawrence	304	38	36.0	+9.5	61	28	10	19	32
Moira	Franklin	800	2	36.0	.....	65	12	12	*5	31
North Hammond	St. Lawrence	420	23	36.5	+8.9	66	29	12	18	28
Ogdensburg	St. Lawrence	258	11	36.3	.....	60	*22	8	19	37
Watertown	Jefferson	486	9	37.4	.....	64	*28	11	5	27
Great Lakes:										
Appleton	Niagara	270	13	38.6	+7.4	65	27	17	*18	29
Baldwinsville	Onondaga	385	23	38.9	+8.8	66	29	16	19	32
Brockport	Monroe	537	2	38.2	.....	67	28	15	*18	29
Buffalo	Erie	768	42	39.2	+9.2	65	12	14	19	28
Lyons	Wayne	426	14	39.0	+6.5	65	29	11	19	28
Oswego	Oswego	335	31	37.4	+7.0	65	29	14	19	24
Palermo	Oswego	460	42	.....	.....	.....	.....	.....	.....	.....
Ridgeway	Orleans	.....	5	38.2	.....	65	28	15	19	29
Rochester	Monroe	523	31	39.4	+9.1	66	12	15	18	27
Volusia	Chautauqua	1,167	2	36.5	.....	64	27	9	19	31
Westfield 3	Chautauqua	568	3	38.3	.....	6	12	13	19	27
Central Lakes:										
Auburn	Cayuga	715	39	39.5	+6.8	66	29	15	*18	34
Fayetteville	Onondaga	.....	3	39.0	.....	71	29	14	19	36
ITHACA	Tompkins	836	23	38.3	+7.5	67	29	15	*18	31
Penn Yan	Yates	750	58	38.8	.....	65	29	14	19	31
Romulus	Seneca	719	11	39.2	+7.1	67	29	15	*18	29

*Also on subsequent dates. *a*, *b*, *c*, etc., indicate number days missing from reports.

CLIMATOLOGICAL DATA FOR NEW YORK, MARCH, 1902 —(*Continued*).

STATIONS.	Counties.	PRECIPITATION, IN INCHES.					SKY.			Prevailing direction of wind.	Observers.
		Total.	Departure from the normal.	Greatest in 24 hours.	Total snowfall (unmelted).	Number rainy days.	Number clear days.	Number partly cloudy.	Number cloudy days.		
Western Plateau:											
Addison	Steuben	2.57	+0.16	0.52	6.0	11	13	8	10	sw.	Dr. H. R. Ainsworth.
Alden	Erie	1.46	.....	0.44	5.0	11	14	0	17	sw.	Ira B. Hawthorne.
Angelica	Allegany	2.53	—0.42	0.51	1.5	13	8	8	15	w, nw.	Prof. Edward McGuire.
Atlanta	Steuben	2.27	—0.26	0.45	1.0	12	5	3	23	w.	F. D. Crouch.
Avon	Livingston	1.58	.....	0.35	T.	8	14	5	12	.....	William G. Markham.
Bolivar	Allegany	2.11	.....	0.39	3.5	10	7	11	13	sw.	Dr. Dorr Cutler.
Elba	Genesee	1.12	.....	0.25	4.0	8	9	6	16	sw.	Joseph S. Wilford.
Elmira	Chemung	2.63	+0.40	0.72	8.0	8	9	9	13	n.w.	Gerity Brothers.
Franklinville	Cattaraugus	1.92	.....	0.44	1.6	13	10	1	20	s.	Dr. John W. Kales.
Hemlock Lake	Livingston	1.53	.....	0.40	T.	7	13	2	16	s.	D. H. Westbury.
Humphrey	Cattaraugus	2.55	—0.20	0.45	5.8	14	6	6	19	sw.	Charles E. Whitney.
Jamestown	Chautauqua	1.90	—1.61	0.38	3.6	13	8	8	15	nw.	G. H. Anderson.
Lockport *d*	Niagara	.....	.....	.....	.....	.....	.....	.....	.....	.....	J. E. Wakeman.
Nunda	Livingston	1.35	.....	0.30	0.2	13	7	6	18	sw.	B. E. Jones.
Shortsville	Ontario	1.98	.....	0.57	T.	10	9	7	15	nw.	C. H. Latting.
South Canisteo	Steuben	2.73	—0.41	0.55	5.5	11	7	11	13	nw.	James E. Wilson.
Wedgewood	Schuyler	2.87	+0.19	0.58	6.0	13	11	7	13	sw.	O. F. Corwin.
Eastern Plateau:											
Binghamton	Broome	3.54	+0.52	0.77	14.2	14	7	7	17	nw.	U. S. Weather Bureau.
Bouckville	Madison	3.70	.....	0.82	13.0	14	8	2	21	nw.	L. W. Griswold.
Cooperstown	Otsego	3.70	+1.04	0.67	10.5	12	7	10	14	nw.	G. Pomeroy Keese.
Cortland *a*	Cortland	3.20	+0.72	1.10	4.0	11	9	8	14	nw.	The Standard.
Griffins Corners	Delaware	3.39	.....	0.69	9.5	13	15	5	11	w.	Sylvenus Kelly.
Meredith	Delaware	4.14	.....	0.65	7.5	13	11	8	12	n.	William Waller.
Middletown	Orange	3.72	—0.63	0.80	8.0	8	15	6	10	nw.	Dr. Selden H. Talcott.
Mohonk Lake	Ulster	6.32	.....	1.25	10.0	8	12	9	10	nw.	Albert K. Smiley.
New Lisbon	Otsego	4.13	.....	1.00	14.5	13	9	3	19	s.	G. A. Yates.
Oneonta	Otsego	3.45	.....	1.11	13.4	9	10	8	13	†	H. W. Lee.
Oxford	Chenango	4.32	+1.64	0.90	12.0	12	9	10	12	s.	John P. Davis.
Perry City (near)	Schuyler	2.28	—0.60	0.54	6.0	12	9	5	17	nw.	W. H. Jeffers.
Port Jervis	Orange	3.23	—0.16	0.91	9.0	10	14	10	7	sw.	Prof. John M. Dolph.
Richmondville	Schoharie	3.54	.....	1.20	15.0	10	13	10	8	w.	Miss Asenath France.

a, *b*, *c*, etc., indicate number days missing from reports. ‡ W, SW, S.

CLIMATOLOGICAL DATA FOR NEW YORK, MARCH, 1902—(*Continued*).

STATIONS	Counties.	PRECIPITATION, IN INCHES.					SKY.			Prevailing direction of wind.	Observers.
		Total.	Departure from the normal.	Greatest in 24 hours.	Total snowfall (unmelted).	Number rainy days.	Number clear days.	Number partly cloudy days.	Number cloudy days.		
Eastern Plateau—(Continued):											
South Kortright	Delaware	3.28	+0.86	0.55	13.0	14	12	6	13	s.	S. W. Andrews.
Straits Corners *b*	Tioga	4.37	.....	1.00	9.5	11	.....	.....	.....	s.	W. E. Elmendorf.
Walton	Delaware	3.75	.....	0.58	12.2	14	10	7	14	s.	Richmond Garrison.
Waverly	Tioga	4.56	+2.19	0.71	9.9	13	7	7	17	nw.	T. P. Yates.
West Berne	Albany	2.50	.....	1.50	15.0	2	10	18	3	w.	E. B. Haverly.
Windham	Greene	4.00	.....	1.08	13.7	13	7	18	6	.....	A. R. Mott.
Northern Plateau:											
Adirondack Lodge	Essex	9.40	.....	1.75	13.0	16	6	14	11	sw.	H. Van Hovenburg.
Axton	Franklin	4.68	.....	1.52	8.0	16	5	7	19	s.	H. E. Barkley.
Gabriels	Franklin	3.98	.....	0.80	9.0	15	7	9	15	ne.	A. C. Davis.
Gloversville	Fulton	3.94	.....	0.96	17.3	9	11	6	14	w.	W. McLean.
Indian Lake	Hamilton	1.65	.....	0.42	6.5	12	10	6	15	w.	Frank Pelon.
Jay	Essex	1.93	.....	1.02	0.5	5	9	7	15	w.	W. C. Taylor.
Keene Valley	Essex	6.58	.....	1.61	8.0	18	7	6	18	nw.	Rev. John Irons.
Little Falls 2	Herkimer	2.87	.....	0.70	4.0	7	10	2	19	w.	E. Ten Eyck Lansing.
Lowville	Lewis	4.80	+2.45	1.59	1.0	11	10	6	15	s.	Charles J. Rice.
North Lake	Herkimer	5.96	.....	1.01	10.0	10	.....	.....	.....	n.	A. J. Yeomans.
Number Four	Lewis	6.35	+2.53	0.95	7.0	13	7	4	20	sw.	B. G. Wray.
Saranac Lake (near)	Essex	2.45	.....	0.50	9.0	17	9	10	12	n.	John Kahlmeyer.
South Schroon	Essex	5.64	.....	1.22	12.3	14	7	10	14	ne.	L. W. Whitney.
West Chazy	Clinton	.....	.....	.....	.....	.....	12	4	15	s.	D. P. Harris.
Atlantic Coast:											
Bedford	Westchester	4.33	.....	1.61	3.0	13	16	7	8	.....	Dr. Henry Herbert.
Cutchogue	Suffolk	6.74	.....	1.95	11.0	12	16	9	6	nw.	William A. Fleet.
New York City	New York	4.32	+0.33	1.22	6.8	14	10	7	14	nw.	U. S. Weather Bureau.
Primrose	Westchester	4.85	.....	1.15	8.0	9	.....	.....	.....	.....	W. A. Cornelius.
Setauket	Suffolk	5.85	+1.42	1.53	7.7	15	15	6	10	w.	Selah B. Strong.
Southampton	Suffolk	6.09	.....	1.70	22.6	14	13	12	6	nw.	W. L. Jagger.
Hudson Valley:											
Albany	Albany	3.24	+0.58	0.81	9.1	16	9	9	13	nw.	U. S. Weather Bureau.
Canaan Four Corners	Columbia	3.47	.....	0.90	9.0	16	11	7	13	.....	W. W. Mayo.

Carmel	Putnam	5.93	.....	1.46	8.5	10	18	3	10	w.	Thomas Manning.
Catskill	Greene	5.73	.....	1.38	9.5	7	12	14	5	nw.	A. D. Wilbur.
Cedar Hill	Albany	3.25	.....	0.93	3.2	11	12	6	13	n.	Schoonmaker & Son.
Greenwich *c*	Washington	5.95	.....	1.28	7.5	15	.....	.....	.....	sw.	Oscar W. Tefft.
Honeymead Brook	Dutchess	3.96	+0.87	0.82	8.2	13	6	11	14	n.	Dr. James Hyatt.
Wappingers Falls	Dutchess	5.04	+0.99	1.10	12.0	11	11	14	6	se.nw.	H. C. Townsend.
Mohawk Valley:											
Canajoharie	Montgomery	4.04	.....	1.40	22.2	7	8	11	12	w.	J. E. Countryman.
Little Falls 1	Herkimer	3.23	.....	0.90	5.0	12	10	9	12	w.	E. Ten Eyck Lansing.
Rome	Oneida	4.40	0.04	1.44	4.0	8	17	9	5	e.	W. H. Bingham.
Champlain Valley:											
Caldwell	Warren	5.92	.....	1.10	21.0	13	10	6	15	sw.	Galloway C. Morris.
Carvers Falls *a*	Washington	5.04	.....	1.50	11.0	9	12	12	7	.....	W. Fancher, C. E.
Glens Falls	Warren	6.47	.....	1.38	12.5	12	6	4	21	n.	Prof. C. L. Williams.
Plattsburg	Clinton	.....	.....	.....	.....	.....	17	8	6	s.	Post Surgeon.
Saratoga Springs	Saratoga	4.23	.....	1.10	14.0	8	8	6	17	ne.	F. G. Burnam.
Ticonderoga	Essex	3.12	.....	1.10	12.0	11	11	9	11	n.	George De Lano.
St. Lawrence Valley:											
Canton	St. Lawrence	2.67	+0.15	1.17	1.0	6	6	7	18	n.	C. W. Bolton.
Moira	Franklin	3.93	.....	1.03	6.0	12	11	8	12	e, w.	C. E. McBride.
North Hammond	St. Lawrence	3.80	+ .63	0.77	1.0	17	10	13	8	s, w.	C. A. Wooster.
Ogdensburg	St. Lawrence	2.99	.....	0.50	1.0	11	9	14	8	e.	Dr. William Mabon.
Watertown	Jefferson	3.93	.....	0.90	2.0	12	13	8	10	n.	H. P. Dunlap.
Great Lakes:											
Appleton	Niagara	1.31	—0.73	0.34	.....	7	8	10	13	nw.	H. A. Van Wagoner.
Baldwinsville	Onondaga	3.07	— .70	0.65	1.0	11	13	8	10	.....	S. C. Suydam.
Brockport	Monroe	1.84	.....	0.40	2.0	12	9	9	13	w.	W. H. Lennon.
Buffalo	Erie	1.81	0.75	0.39	3.2	17	5	8	18	w.	U. S. Weather Bureau.
Lyons	Wayne	2.05	—0.57	0.60	1.0	7	.....	.....	.....	w.	Dr. M. A. Veeder.
Oswego	Oswego	3.80	+1.18	0.85	2.7	14	7	5	19	s	U. S. Weather Bureau.
Palermo	Oswego	1.89	—0.94	0.70	.....	11	9	8	14	nw.	E. B. Bartlett.
Ridgeway	Orleans	1.84	.....	0.26	3.1	13	10	10	11	‡	M. E. Weld.
Rochester	Monroe	1.48	—1.38	0.31	1.2	13	7	13	11	w.	U. S. Weather Bureau.
Volusia	Chautauqua	1.81	.....	0.70	.....	12	10	7	14	s.	Benjamin Breads.
Westfield 3	Chautauqua	1.00	.....	0.23	1.0	13	11	4	16	ne, s.	D. H. Beadle.
Central Lakes:											
Auburn	Cayuga	1.64	—0.69	0.75	1.0	10	10	11	10	n.	A. H. Underwood.
Fayetteville	Onondaga	3.02	.....	0.90	8.0	12	8	8	15	nw.	Dana H. Wells.
Ithaca	Tompkins	3.04	+0.67	0.73	9.7	13	7	6	18	nw.	SECTION CENTRE.
Penn Yan	Yates	1.95	+0.12	0.43	0.5	9	7	6	18	nw.	Ralph L. Eastman.
Romulus	Seneca	2.17	—0.58	0.72	3.0	8	10	7	14	nw.	John H. Coryell.

NOTE.— Mean temperatures are derived from the daily extremes by the maximum and minimum thermometers. All records are used in determining State or district means but State and district departures are determined by comparison of current data of only such station as have normals.

a, b, c, etc., indicate number days missing from reports. ‡ E, SW, NW.

MAXIMUM AND MINIMUM TEMPERATURES FOR NEW YORK, MARCH, 1902.

STATIONS.	1.		2.		3.		4.		5.		6.		7.		8.		9.		10.		11.		12.		13.		14.		15.		16.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Western Plateau:																																
Addison	60	38	42	34	35	30	33	22	27	23	43	9	47	23	43	31	41	35	53	34	54	30	69	39	59	33	48	24	54	28	52	41
Alden	52	40	44	32	32	27	27	13	29	13	37	9	45	33	41	32	29	31	51	31	58	40	65	51	59	34	43	22	62	32	55	41
Angelica	56	36	50	31	33	25	30	17	28	17	41	9	48	27	48	29	39	32	53	29	58	32	64	43	62	29	46	18	50	31	52	42
Atlanta	55	32	50	31	32	25	27	17	25	18	40	15	45	31	42	31	38	32	52	30	55	34	62	49	56	30	43	22	50	32	51	39
Avon	55	35	46	30	32	19	30	19	40	12	49	31	42	29	45	30	40	30	49	30	61	31	66	46	62	32	42	20	56	28	55	14
Bolivar	52	34	50	28	29	24	31	13	25	17	40	9	44	21	41	30	36	31	54	27	55	27	62	37	60	31	46	19	52	28	50	40
Elba	50	37	38	30	36	28	28	16	28	18	35	15	43	33	35	29	35	39	48	30	55	37	62	46	46	32	40	25	53	30	54	41
Elmira	57	41	54	34	34	30	32	23	28	20	39	19	46	27	43	33	38	34	46	35	53	34	68	57	59	33	46	27	51	32	55	34
Franklinville	50	34	44	28	20	24	26	14	26	17	38	12	45	30	41	30	38	30	54	28	55	34	63	44	58	30	44	20	55	32	50	41
Hemlock Lake	52	36	41	33	36	28	29	20	28	17	37	17	45	29	42	31	39	33	46	33	50	36	59	44	52	32	40	24	50	24	52	42
Humphrey	49	38	46	35	36	17	29	13	22	14	34	14	43	16	38	30	34	28	47	25	54	37	60	45	57	26	40	18	50	32	46	38
Jamestown	55	36	50	30	31	25	30	12	29	20	42	14	48	29	43	33	41	31	58	30	62	36	69	48	65	32	51	21	59	34	55	44
Nunda	57	39	55	33	35	29	37	19	34	20	39	16	49	31	49	28	42	34	55	31	61	37	67	49	65	35	44	21	59	33	59	43
Shortsville	56	36	42	32	35	28	30	21	28	19	38	18	47	31	43	29	40	31	46	31	56	36	64	46	58	31	41	25	53	29	55	39
South Canisteo	58	32	46	30	36	26	29	18	27	20	47	7	50	28	42	32	42	33	56	30	57	35	60	40	56	30	47	20	53	29	50	40
Wedgewood	54	37	47	31	33	26	28	18	21	18	38	15	42	26	40	32	36	32	47	29	52	33	64	45	52	28	40	22	48	22	52	40
Eastern Plateau:																																
Binghamton	53	42	49	34	35	29	29	21	28	20	34	17	45	20	44	30	38	33	42	31	51	29	64	47	57	32	44	26	49	30	58	41
Cooperstown	55	37	41	35	37	29	27	17	22	12	27	14	44	17	37	25	37	32	35	30	54	23	62	42	48	35	36	25	50	22	55	37
Griffins Corners	54	36	54	36	38	27	30	20	25	19	29	13	49	5	41	24	41	31	41	28	55	20	63	41	55	35	47	23	50	23	54	33
Meredith	49	36	46	32	32	26	28	18	22	15	22	9	40	13	38	26	36	28	32	27	46	27	51	42	58	30	40	19	44	23	50	32
Middletown	54	39	57	40	41	32	35	27	32	22	32	25	41	22	41	20	41	33	45	31	50	30	59	39	56	37	45	32	43	29	55	37
Mohonk Lake	53	38	52	37	40	29	35	23	31	18	33	19	44	22	39	29	37	29	47	30	46	27	55	37	56	45	47	23	41	26	51	33
New Lisbon	54	35	46	32	35	27	30	18	26	17	28	9	43	3	40	23	38	28	36	26	49	19	60	40	52	28	41	20	49	21	55	35
Oneonta	58	41	51	35	36	30	34	23	27	20	34	14	47	12	41	28	38	27	39	30	55	25	66	46	56	33	50	24	53	24	56	37
Oxford	54	36	50	34	38	29	33	22	28	18	33	12	47	8	42	23	45	32	40	30	50	22	65	35	66	34	43	22	50	24	55	34
Perry City (near)	52	34	48	32	37	26	30	18	26	16	35	14	50	18	42	26	38	31	41	28	52	27	66	42	54	32	40	20	49	23	55	35
Port Jervis	59	39	45	37	39	32	38	27	36	23	38	22	50	10	46	30	43	34	50	36	56	27	65	39	62	39	55	32	48	25	56	39
Richmondville	57	38	51	35	39	30	30	22	23	18	23	15	45	18	45	24	36	31	38	30	54	21	63	45	57	34	44	24	52	22	65	31
South Kortright	55	39	50	35	36	29	30	22	25	19	28	14	45	1	42	22	40	31	39	29	50	20	64	45	55	35	45	18	50	18	54	30
Walton	56	41	53	36	38	30	31	23	28	21	28	15	46	5	44	25	40	32	39	31	51	21	63	46	55	33	47	19	47	24	54	45
Waverly	59	34	49	33	37	29	34	22	28	22	41	16	48	13	47	28	40	34	49	34	52	26	67	38	56	34	49	24	56	25	59	38
Windham	57	37	50	39	38	30	32	20	27	18	27	15	47	3	41	20	40	32	41	28	54	17	65	42	58	38	41	24	49	21	53	34
Northern Plateau:																																
Axton	54	39	42	28	34	25	26	11	23	2	31	17	37	12	38	11	39	25	40	26	54	19	57	40	52	26	40	13	52	15	51	31
Gabriels	53	39	45	32	37	25	27	12	20	2	28	9	33	16	34	8	40	22	42	25	52	22	51	39	48	27	39	13	53	20	51	39
Indian Lake	52	35	44	27	40	26	28	17	24	5	32	10	42	6	37	21	36	27	44	27	52	17	56	38	51	30	48	18	48	13	49	29

Jay	58	36	45	31	39	33	34	21	36	14	36	15	40	15	33	13	43	26	46	31	60	23	65	41	57	31	39	11	58	18	59	37
Keene Valley	57	39	40	30	40	31	31	16	24	10	36	14	47	17	35	14	40	30	45	27	54	22	63	40	55	30	39	16	52	19	52	36
Little Falls 2	54	36	50	33	38	27	29	18	25	12	27	13	42	9	40	26	38	30	36	28	50	31	51	34	52	36	51	21	48	20	48	31
Lowville	50	38	41	32	35	25	25	18	28	13	29	13	40	24	41	26	39	29	40	29	46	26	57	40	51	29	41	18	49	26	53	35
North Lake	54	39	52	31	44	29	30	15	23	8	26	10	28	12	42	24	44	47	39	23	40	39	50	38	55	40	50	14	47	20	51	33
Number Four	51	39	41	32	34	23	25	15	26	6	26	8	38	13	41	25	38	27	39	26	47	27	54	40	53	28	41	16	49	26	52	36
Saranac Lake	54	38	44	32	36	27	28	26	28	3	31	17	36	20	53	9	40	23	42	26	60	20	56	42	54	27	41	15	56	18	53	37
South Schroon	53	35	48	34	40	30	39	19	24	13	36	15	46	14	39	20	36	28	43	29	46	20	57	36	57	31	39	18	48	17	48	34
West Chazy	50	36	42	33	40	34	34	21	27	15	30	16	37	20	30	11	39	23	37	25	44	24	53	37	52	31	34	20	47	21	49	34
Atlantic Coast:																																
Bedford	57	44	51	40	51	32	39	29	35	23	33	22	45	13	44	30	40	35	48	35	50	28	64	40	63	40	46	30	44	25	55	35
Cutchogue	55	36	53	40	42	31	41	32	39	28	39	26	50	22	47	31	49	35	48	34	47	28	56	39	56	43	56	32	46	35	57	35
New York City	63	46	53	37	43	33	39	33	37	28	37	27	45	28	46	39	46	39	50	39	50	38	65	45	63	40	49	33	46	37	52	41
Primrose	57	40	52	36	50	34	43	31	35	32	40	25	48	18	46	30	42	36	52	32	51	28	65	36	60	45	49	33	46	26	60	38
Setauket	57	42	53	38	43	33	40	33	35	27	34	25	44	23	46	33	45	37	47	35	50	29	63	39	57	41	46	33	46	28	60	37
Southampton	52	40	48	42	44	39	40	33	39	28	35	27	40	21	43	31	47	37	47	39	46	29	49	38	48	43	48	34	45	27	50	36
Hudson Valley:																																
Albany	57	44	49	38	42	32	34	25	28	22	32	20	45	20	37	27	37	30	44	32	49	28	61	43	58	34	43	29	50	26	56	39
Canaan Four Corners	56	43	50	39	40	30	31	23	35	20	35	10	45	25	39	29	38	31	35	30	48	25	61	40	59	39	43	24	50	24	51	35
Catskill	55	41	50	41	47	35	40	29	31	23	35	20	47	18	38	32	39	32	48	33	60	33	58	38	60	36	37	30	48	30	47	26
Cedar Hill	56	41	48	37	44	33	35	26	27	23	33	20	46	16	38	27	38	27	44	34	48	25	62	41	63	35	48	28	50	23	55	37
Greenwich	57	41	51	39	43	34	36	26	31	21	...	...	44	19	...	...	40	23	39	32	49	22	60	39	61	35	...	...	53	22	55	32
Honeymead Brook	57	43	52	43	45	34	38	28	28	24	30	21	46	11	46	29	42	35	43	32	50	25	63	41	66	30	50	29	49	23	56	37
Wappingers Falls	55	40	54	41	46	35	45	32	35	24	37	18	45	11	45	35	42	33	46	29	50	25	62	37	66	41	45	30	42	24	55	39
Mohawk Valley:																																
Canajoharie	49	35	48	35	40	29	31	22	25	18	26	15	44	7	40	26	37	28	37	31	42	20	50	35	55	37	46	25	47	23	56	32
Little Falls 1	54	39	51	33	37	28	34	21	26	16	26	14	43	17	39	27	39	28	34	28	42	25	55	40	58	33	46	22	46	24	51	32
Rome	51	38	48	37	41	31	32	22	27	19	29	15	45	20	41	33	36	32	37	31	50	30	56	42	56	35	42	26	50	30	58	35
Champlain Valley:																																
Caldwell	52	35	44	34	40	33	39	23	26	20	28	11	46	10	35	24	38	26	39	28	44	21	54	37	59	32	42	25	46	20	51	35
Glens Falls	54	38	50	37	43	33	38	27	33	22	32	19	46	17	44	23	37	28	41	32	47	24	57	39	60	44	44	26	54	23	44	36
Plattsburg	51	27	49	31	41	35	42	20	33	10	28	15	40	18	42	10	36	24	36	28	45	34	53	35	51	30	39	19	50	18	54	32
Saratoga Springs	57	40	49	38	51	34	37	24	30	21	40	23	48	27	47	26	40	30	41	31	49	22	58	37	59	33	41	27	39	21	55	34
Ticonderoga	56	35	52	35	42	33	42	25	30	19	35	16	44	11	40	18	37	25	41	29	50	20	58	39	58	31	43	23	50	22	52	40
St. Lawrence Valley:																																
Moira	55	37	44	33	38	28	29	19	26	12	26	12	37	24	33	12	36	22	38	28	53	28	65	50	55	32	32	25	44	21	59	34
North Hammond	52	40	44	36	36	30	30	20	26	18	20	14	40	18	30	16	40	18	40	16	44	18	52	44	50	34	42	28	52	24	52	40
Ogdensburg	55	35	58	25	41	25	30	15	29	16	26	12	35	25	44	13	34	13	38	23	47	25	51	40	49	33	45	23	52	20	57	20
Watertown	52	39	43	35	38	29	29	18	27	11	28	13	42	27	36	23	41	30	38	26	52	27	60	46	57	32	39	23	53	27	58	41
Great Lakes:																																
Appleton	48	37	41	30	36	27	30	21	32	19	38	22	44	35	37	30	38	32	44	32	58	29	64	48	60	34	39	26	59	30	57	46
Baldwinsville	55	35	42	34	38	30	33	23	30	19	37	11	47	28	40	13	37	31	41	32	51	30	62	46	58	32	42	26	54	29	58	39

MAXIMUM AND MINIMUM TEMPERATURES FOR NEW YORK, MARCH, 1902—(*Continued*).

STATIONS.	1.		2.		3.		4.		5.		6.		7.		8.		9.		10.		11.		12.		13.		14.		15.		16.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Great Lakes—(Continued):																																
Brockport	48	39	40	32	34	29	30	19	30	20	37	17	44	32	36	30	37	31	43	30	56	31	61	45	56	32	40	25	56	28	56	40
Buffalo	49	40	47	31	31	24	25	19	30	22	36	22	44	35	42	34	42	33	53	32	57	46	65	49	53	31	44	31	59	37	54	37
Lyons	58	39	42	36	36	30	32	21	20	20	41	25	50	31	40	36	40	37	47	34	50	34	56	46	47	32	39	30	56	29	59	39
Oswego	57	37	44	34	35	26	26	20	28	20	33	20	45	29	39	30	36	30	36	31	53	32	62	47	56	32	35	29	53	29	58	40
Ridgeway	50	38	42	34	34	26	28	18	29	19	36	17	45	35	36	30	37	32	43	31	57	30	63	52	59	33	40	26	58	29	57	39
Rochester	58	42	42	32	32	25	27	21	30	22	40	22	45	34	42	33	37	33	47	31	60	39	66	51	56	33	40	36	56	33	56	43
Volusia	48	39	43	26	26	23	25	14	25	17	37	14	45	30	44	34	37	29	49	28	55	40	63	50	59	29	40	21	54	29	51	23
Westfield 3	53	37	44	29	32	26	27	17	27	22	40	18	49	35	45	36	41	32	47	32	60	44	69	50	57	31	38	22	57	31	54	41
Central Lakes:																																
Auburn	50	39	45	33	35	30	32	22	28	19	38	17	47	29	47	32	42	30	40	30	52	35	65	45	59	32	45	25	60	30	60	43
Fayetteville	62	35	46	34	42	32	32	22	28	18	36	16	48	21	40	30	40	30	42	32	54	30	66	46	60	31	46	20	50	26	60	40
Ithaca	58	42	46	34	36	25	28	19	28	19	37	18	46	32	43	36	38	31	42	32	54	35	66	51	57	29	42	25	51	33	56	41
Penn Yan	58	38	42	34	34	29	29	22	26	22	40	18	48	29	44	32	39	34	47	32	55	35	64	39	55	31	42	26	53	29	55	40
Romulus	58	38	45	35	36	30	32	21	27	20	39	17	48	32	45	32	41	33	43	31	56	34	65	48	56	31	44	24	52	29	57	41

MAXIMUM AND MINIMUM TEMPERATURES FOR NEW YORK, MARCH, 1902—(*Continued*).

STATIONS.	17.		18.		19.		20.		21.		22.		23.		24.		25.		26.		27.		28.		29.		30.		31.		MONTHLY MEAN.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Northern Plateau:																																
Addison	53	33	34	15	28	14	38	25	49	31	55	35	62	32	50	26	52	23	62	23	58	34	58	43	68	49	60	31	46	32	49.5	29.7
Alden	47	20	24	12	27	11	37	11	43	31	53	33	54	32	45	27	49	25	53	27	64	41	69	49	59	41	55	38	40	32	47.0	29.3
Angelica	51	23	25	10	27	9	35	20	47	24	55	29	57	27	47	20	56	18	61	19	65	41	64	43	61	44	57	28	42	30	48.6	26.8
Atlanta	51	21	22	11	24	11	32	22	44	30	53	31	56	30	45	25	49	22	60	22	62	39	55	43	63	42	58	29	43	28	46.5	28.2
Avon	54	24	28	12	27	12	35	24	43	31	53	29	54	28	42	32	48	21	54	21	64	38	64	43	63	45	56	30	51	32	48.6	28.5
Bolivar	48	24	24	7	23	8	35	19	49	29	53	31	59	27	49	20	50	20	60	19	64	39	60	43	58	42	56	29	40	28	46.9	25.8
Elba	44	22	22	13	25	11	33	23	41	29	51	36	49	32	50	29	55	25	61	27	55	40	61	47	60	43	50	35	45	31	44.8	29.8
Elmira	43	30	33	16	28	13	38	25	48	33	55	37	57	30	66	34	49	27	58	29	56	40	55	44	68	49	68	42	58	33	49.3	31.5
Franklinville	41	11	18	7	26	8	32	19	52	27	51	34	51	29	49	22	49	21	63	21	65	41	55	45	57	42	53	30	38	29	45.7	26.9
Hemlock Lake	45	27	27	15	25	14	34	24	42	33	52	32	53	32	42	26	48	25	55	29	58	40	53	43	59	45	56	36	45	33	44.9	30.1
Humphrey	42	18	18	6	20	5	30	17	43	24	48	34	57	33	53	26	52	24	55	25	63	44	58	42	55	29	53	30	39	24	43.9	26.0
Jamestown	51	21	22	11	27	8	41	20	53	30	59	36	60	30	61	24	56	24	67	23	66	44	67	47	60	43	64	42	42	28	51.1	29.2
Nunda	53	27	38	12	28	12	35	23	47	30	55	29	55	23	60	24	50	21	62	22	68	36	62	47	62	46	60	32	44	32	51.2	29.5
Shortsville	52	27	30	15	27	15	36	24	41	32	52	32	53	33	45	28	48	24	58	27	62	39	60	45	65	46	56	34	47	34	47.2	30.2
South Canisteo	52	22	25	12	27	11	35	20	46	27	55	31	59	28	49	21	54	20	62	22	61	35	54	42	68	45	60	30	45	32	48.6	27.4
Wedgewood	49	25	26	11	24	11	35	21	41	29	51	33	54	34	55	28	46	18	54	27	52	41	56	42	61	45	56	35	42	30	45.0	28.5
Eastern Plateau:																																
Binghamton	54	23	23	15	26	15	34	24	39	34	55	35	55	34	45	27	48	26	57	26	54	39	55	41	67	48	60	38	41	31	46.4	30.3
Cooperstown	54	25	25	15	22	12	31	17	42	26	44	34	50	36	41	26	42	25	47	24	52	30	57	42	65	47	50	40	47	32	43.1	27.8
Griffins Corners	52	32	34	14	22	11	30	14	40	25	56	33	55	32	46	23	47	22	59	20	53	24	53	36	59	44	62	36	52	29	46.6	26.1
Meredith	50	29	31	10	17	8	25	14	34	24	47	32	48	34	40	26	42	23	49	24	47	28	50	36	60	42	57	36	52	27	41.4	25.7
Middletown	56	41	41	21	28	19	40	24	52	34	59	36	61	37	54	37	50	29	53	30	54	34	49	39	68	45	62	44	54	36	48.6	32.3
Mohonk Lake	50	37	39	19	26	15	40	20	52	31	55	35	58	37	54	34	46	27	51	27	48	30	45	34	62	41	62	39	56	30	46.8	29.8
New Lisbon	54	23	23	12	22	11	30	17	39	28	52	32	54	30	43	20	46	20	55	19	51	25	58	34	64	44	59	37	48	29	44.5	24.6
Oneonta	55	30	30	16	28	14	33	19	40	32	58	35	59	37	50	24	53	24	60	22	54	28	58	58	67	47	61	41	49	31	48.3	28.7
Oxford	55	33	37	14	25	13	33	19	42	27	55	33	57	34	49	22	48	22	55	20	59	38	57	38	67	45	60	33	56	31	48 2	27.0
Perry City (near)	50	28	28	9	25	11	35	20	41	28	52	32	53	27	42	24	46	20	53	20	55	33	57	40	67	45	59	48	50	28	46.1	26.9
Port Jervis	53	39	29	21	30	19	40	24	55	36	67	31	66	33	59	34	58	25	60	22	57	25	50	40	70	42	69	43	56	32	52.1	30.8
Richmondville	59	29	34	16	30	11	30	11	43	29	57	33	54	35	47	29	51	24	54	24	55	33	59	42	67	44	59	45	55	21	47.6	27.9
South Kortright	55	33	33	15	24	12	30	16	41	24	53	33	55	33	48	22	46	22	55	20	52	28	56	40	64	48	62	40	55	31	46.4	26.7
Walton	55	31	34	16	25	20	31	19	40	29	54	35	57	37	55	23	48	23	57	21	53	32	53	39	65	48	61	37	60	30	47.4	28.6
Waverly	54	26	28	14	28	15	39	25	46	33	60	35	61	29	52	22	53	21	65	22	59	29	56	42	70	44	64	30	53	29	50.3	27.9
Windham	55	31	33	17	22	13	32	15	47	28	54	35	54	34	47	24	46	22	52	19	54	21	58	39	63	47	59	30	54	30	46.8	26.8
Northern Plateau:																																
Axton	49	24	47	14	27	8	34	17	43	30	50	31	45	31	37	18	44	19	52	15	56	18	62	39	54	34	53	37	41	27	43.4	22.6
Gabriels	48	25	23	13	20	7	34	17	41	29	50	35	47	33	37	21	46	23	52	21	57	25	64	39	55	44	52	36	38	28	42.5	24.1

MAXIMUM AND MINIMUM TEMPERATURES FOR NEW YORK, MARCH, 1902—(*Continued*).

STATIONS.	17.		18.		19.		20.		21.		22.		23.		24.		25.		26.		27.		28.		29.		30.		31.		MONTHLY MEAN.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Nor. Plateau—(Con.):																																
Indian Lake	50	30	32	13	19	8	36	14	47	29	54	26	51	26	44	15	51	17	53	12	54	16	57	32	54	38	57	38	46	29	44.8	22.2
Jay	56	35	35	20	23	14	40	20	45	34	49	31	54	27	44	21	48	22	53	22	64	21	66	38	64	48	56	38	45	36	47.7	26.6
Keene Valley	52	30	30	19	22	13	37	13	45	34	50	35	52	28	40	21	46	25	53	20	56	21	65	41	56	47	57	38	42	28	45.6	25.9
Little Falls 2	50	30	36	15	19	10	33	17	46	29	54	30	53	30	51	23	51	24	52	20	53	43	58	38	60	44	55	38	51	32	45.2	26.7
Lowville	51	25	25	10	25	10	32	25	40	31	48	32	49	29	41	28	44	24	57	22	52	27	61	40	61	43	57	39	49	31	43.8	27.0
North Lake	51	30	33	11	20	6	26	8	35	26	47	33	52	30	51	21	40	21	56	20	51	25	61	45	58	46	59	37	56	31	44.2	24.9
Number Four	52	22	23	11	19	6	30	20	41	29	48	33	48	29	40	21	47	21	53	21	51	31	60	40	58	42	52	37	48	30	42.7	25.2
Saranac Lake	51	27	28	14	17	8	32	17	43	30	49	34	48	34	38	21	46	23	54	19	59	22	66	43	56	46	54	36	41	31	44.3	25.3
South Schroon	51	31	32	17	25	13	41	21	50	34	54	32	54	28	44	26	46	27	51	23	54	24	57	29	56	43	55	40	43	33	45.3	26.3
West Chazy	50	34	34	20	26	16	42	23	48	40	49	41	50	32	45	28	46	29	56	28	54	27	58	36	57	44	51	43	47	37	47.3	28.4
Atlantic Coast:																																
Bedford	54	40	42	23	30	20	42	25	29	35	69	40	69	40	52	36	50	30	55	26	52	30	50	38	56	45	63	40	50	35	50.3	32.4
Cutchogue	50	40	45	31	32	24	44	30	55	35	63	38	62	38	64	31	52	33	54	29	50	29	50	40	51	44	62	43	52	36	50.5	33.8
New York City	53	43	43	23	32	21	44	31	56	38	63	39	63	44	55	43	53	35	54	38	52	39	53	42	63	47	60	48	48	38	50.8	37.2
Primrose	65	34	34	27	33	22	46	28	69	34	65	35	68	40	56	32	57	28	56	29	54	26	51	37	58	45	62	38	51	30	52.3	32.4
Setauket	53	42	42	26	30	24	43	29	54	37	62	37	61	40	52	34	50	35	51	29	53	32	51	40	55	48	61	42	51	38	49.5	34.4
Southampton	50	43	45	29	32	23	43	25	55	34	63	39	59	38	52	33	51	33	50	30	47	30	46	38	50	44	57	43	52	40	47.5	34.4
Hudson Valley:																																
Albany	53	31	31	22	30	20	38	26	50	35	59	38	60	35	45	32	50	31	56	29	54	33	51	41	62	48	59	44	50	34	47.4	31.9
Canaan Four Corners	53	32	32	20	23	15	30	23	43	30	55	35	55	31	46	26	49	24	53	24	52	31	45	37	57	45	61	41	50	31	45.8	29.4
Catskill	50	41	55	35	36	22	29	21	40	25	56	37	61	41	62	37	52	34	50	30	49	26	54	30	51	40	61	45	52	34	48.3	32.1
Cedar Hill	55	34	36	23	31	19	38	22	52	35	60	38	61	33	42	27	52	30	57	27	55	32	52	39	62	46	62	42	50	34	48.4	30.8
Greenwich	57	35	37	24	27	12	35	22	47	32	54	34	55	30	50	26	48	28	53	24	54	25	55	34	59	48	60	44	48	37	48.5	30.0
Honeymead Brook	46	35	41	24	28	20	39	21	52	34	56	36	60	39	46	30	46	28	53	25	53	32	50	39	64	42	64	43	50	35	48.7	31.5
Wappingers Falls	53	36	36	22	33	22	47	27	54	35	59	31	63	37	55	31	56	27	53	27	57	29	51	40	65	49	63	45	57	37	50.7	31.9
Mohawk Valley:																																
Canajoharie	54	27	34	18	26	15	33	19	46	30	56	33	54	31	50	25	52	24	53	22	54	26	54	35	67	43	56	41	53	34	46.0	27.1
Little Falls 1	50	27	28	18	28	12	32	19	40	20	54	32	53	32	49	26	55	24	51	26	54	31	57	38	66	44	54	45	52	33	45.3	27.8
Rome	58	30	30	19	28	14	34	25	46	31	55	34	55	30	54	24	51	26	55	26	55	32	59	42	66	48	56	40	59	35	47.1	30.1
Champlain Valley:																																
Caldwell	52	33	33	22	25	18	38	25	52	38	56	35	54	32	46	26	49	28	52	23	49	25	50	35	59	43	58	42	47	33	45.3	28.2
Glens Falls	55	40	41	24	28	19	39	22	50	33	57	34	56	35	49	28	51	28	57	27	55	29	56	37	60	46	58	46	51	39	48.0	30.8
Plattsburg	57	38	51	20	29	15	44	20	50	38	52	35	53	29	54	29	47	29	49	25	52	25	57	38	59	39	52	40	49	35	46.7	27.1
Saratoga Springs	54	36	41	22	29	20	47	23	49	32	58	31	62	37	56	31	54	24	58	25	57	27	54	38	63	45	59	49	53	34	49.5	30.4
Ticonderoga	61	37	42	23	46	19	40	24	43	35	49	35	53	31	46	29	50	28	59	26	54	39	59	40	65	42	58	42	47	37	47.8	29.3

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DAILY PRECIPITATION FOR NEW YORK, MARCH, 1902.

STATIONS.	DAY OF MONTH.															
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
Western Plateau:																
Addison	.38	.52	T.	.....	.45	.03	.....	.....	.24	.....	T.	T.	T.	.....	.....	.42
Akron	.13	.33	.07	.....	.....	.....	.....	T.	.05	.....	.....	T.	.17	.....	.....	.22
Alden	.02	.03	.40	.....	.....	.....	.....	T.	.....	.....	.03	.09	.09	.....	.....	.05
Angelica	.51	.19	.07	.....	.05	.....	.....	.....	.15	.....	.....	.....	.40	.....	.....	.20
Atlanta	.38	.40	.05	.....	.07	.....	.....	.....	.35	.....	.....	.....	.16	.....	.....	.45
Avon	.21	.35	.....	.....	.....	.....	.....	.....	T.	.35	.....	.....	.14	.....	.....	T.
Bolivar	.31	.18	.23	T.	.03	T.	.....	T.	T.	.....	.....	T.	.39	T.	.....	.33
Elba	.25	.10	.30	.....	.....	.....	.....	T.	T.	.....	T.	T.	.10	.....	.....	.05
Elmira	.24	.52	.....	.....	.40	.....	.....	.....	.29	.....	.....	.....	.....	.....	.....	.72
Franklinville	T.	.24	.11	.05	.....	.....	.....	T.	T.	.....	.12	T.	.44	.....	.....	.20
Hemlock Lake	.....	.31	.....	.....	.....	.....	.....	.32	.....	.....	.....	.40	T.	.....	.....	.10
Humphrey	T.	.37	T.	.....	.01	.....	.....	.17	.05	.....	.45	.12	.....	.....	.....	.30
Jamestown	.....	.20	.08	.....	.....	.....	.....	.05	.12	.....	T.	.05	.38	.....	.....	.10
Nunda	.20	.13	.....	.02	.....	.....	.....	.....	.21	.....	.....	.05	.30	.....	.....	.10
Shortsville	.41	.40	T.	.....	.....	.....	.....	.05	.57	.....	.....	.....	.03	.....	.....	.17
South Canisteo	T.	.45	T.	.....	.40	.....	.....	.30	.....	.....	T.	.....	.25	.....	.....	.55
Wedgewood	.24	.58	.05	.....	.40	.10	.....	T.	.31	.....	.....	.....	.03	T.	.....	.56
Eastern Plateau:																
Binghamton	.37	.75	.04	T.	.77	.06	.....	T.	.20	.....	T.	T.	.05	T.	.....	.40
Bouckville	.82	.64	.09	.05	.25	.50	.....	.....	.12	.....	.....	.05	.03	.15	.....	.....
Cooperstown	.65	.67	.....	.....	.55	.....	.....	.....	.40	.....	T.	.....	.14	.....	.....	.44
Cortland	.61	1.10	.15	.02	.13	.20	.....	.....	.....	.....	.29	.14	.06	.....	.....	.....
Griffins Corners	.30	.48	.04	.....	.69	.20	.....	.....	.11	.....	.....	.....	.03	T.	.....	.06
Meredith	.34	.65	T.	T.	.46	.15	.....	.....	.19	T.	T.	.21	.44	T.	.....	.09
Middletown	.45	.60	T.	.....	.80	.....	.....	T.	.78	.....	.....	.....	T.	.....	.....	.03
Mohonk Lake	1.25	.90	T.	.....	1.00	.....	.....	.....	1.15	.....	.....	.....	.....	.....	.....	.....
Newark Valley	.40	.87	T.	.....	.60	.....	.....	.....	.50	.....	T.	.....	.10	.....	.....	.55
New Lisbon	.50	.75	.....	.....	1.00	.20	.....	.....	.44	.....	.....	.....	.09	.....	.....	.06
Oneonta	.....	.57	T.	.....	1.11	.....	.....	.26	.11	.....	T.	.....	.09	.....	.....	.....
Oxford	.50	.72	T.	T.	.90	.30	.....	.....	.36	.....	T.	.03	.08	.....	.....	T.
Perry City (near)	.....	.54	.20	T.	.18	.....	.....	.....	.11	.....	T.	.....	.04	.....	.....	.44
Port Jervis	.38	.52	.....	.....	.91	.....	.....	.33	.....	.....	.....	.02	.....	.....	.....	.35
Richmondville	.25	.55	T.	.....	1.20	.15	.....	.....	.20	.....	.....	.....	.25	T.	.....	.....
Salisbury Mills	.40	.51	.....	.....	.90	.....	.....	.07	.83	.....	.....	.....	.....	.....	.....	.....

South Kortright	.37	.55	.....	T.	*	.50	.....	.....	.26	.....	.....	.....	.14	T.	.....	.02
Straits Corners	.....	1.00	.....	.10	.60	.20	.....	.....	.44	.....	.....	.....	.05	.....	.....	.92
Walton	.45	.58	.10	.....	.40	.20	.....	.....	.23	.....	.....	.....	.17	.....	.....	.10
Warwick	.48	.52	.05	.....	1.15	.52	.....	.30	.15	.....	.....	.....	.07	.03	.....	.07
Waverly	.25	.60	.02	.....	.70	.04	.....	.....	.38	T.	.....	T.	.40	T.	.....	.71
West Berne	.....	1.00	.....	.....	1.50	.....	.....	.....	.....	.....	.....	T.	T.	T.	.....	T.
Windham	.29	.44	.....	.....	1.08	.32	.....	.....	.15	.....	.....	.....	.02	.....	.....	.08
Northern Plateau:																
Axton	.43	.....	1.52	.04	.02	.....	T.	.....	.06	.....	.20	.45	.49	.....	.....	.....
Gabriels	.20	.80	.48	.....	.....	T.	T.	.....	.10	.....	.04	.40	.48	T.	.....	.....
Gansevoort	1.10	1.35	.....	.....	1.00	.....	.....	.....	.43	.....	.10	.....	.15	.....	.....	.20
Indian Lake	.02	.07	.01	.....	.20	.02	.....	.....	.35	.....	T.	.03	.01	.....	.....	.02
Jay	.25	1.02	.11	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.	.....	.....	.....
Keene Valley	.40	1.61	.26	T.	.12	.10	T.	T.	.14	T.	T.	.12	.25	.....	.....	.50
Little Falls 2	.47	.55	.....	.....	.08	.....	.....	.....	.12	.....	.....	.30	.....	.....	.....	.....
Lowville	.44	.76	.54	.....	.....	.....	.....	.....	.23	.....	.03	.36	.43	.....	.....	.76
North Lake	.99	.....	.95	.....	.....	.40	.....	.....	.54	.....	.....	.39	.13	T.	.....	.30
Number Four	.69	.67	.40	.....	.....	.....	.....	.....	.14	.....	.....	.47	.95	.....	.....	.62
Saranac Lake	.....	.37	.33	.04	.....	.06	.....	.....	.09	T.	T.	.02	.08	.....	.....	T.
Speculator	.90	.....	.....	.....	.40	.....	.....	.....	.55	.....	.....	.....	.....	.....	.....	1.25
South Schroon	.92	.92	.29	T.	.07	.23	.....	.....	.63	.....	.....	.10	.11	.....	.....	.27
Atlantic Coast:																
Bedford	.15	.15	.21	.....	.30	.....	.....	.07	.93	.....	.....	.....	.07	T.	.....	.15
Cutchogue	.....	.90	.05	.....	1.95	.10	.....	.28	1.10	.....	.....	.....	.03	.13	.....	.....
New York City	.03	.65	.03	.....	1.22	.03	.....	.33	.89	.....	.....	T.	.08	.01	.....	.02
Primrose	.....	.78	.....	.....	.72	.....	.....	1.15	.42	.....	.....	T.	.12	.....	.....	.02
Setauket	.10	.47	.03	.....	1.53	.03	.....	.13	1.17	.....	.....	.....	.06	T.	.....	.....
Southampton	.51	.40	.05	.....	1.70	.09	.....	.95	.....	.....	.....	.....	.14	.10	.....	T.
Hudson Valley:																
Albany	.38	.81	T.	T.	.56	.16	.....	.01	.43	T.	T.	.....	.01	.01	.....	.04
Athens	.45	1.15	T.	T.	1.20	.....	.....	T.	.89	.....	.....	.....	.02	T.	.....	.05
Canaan Four Corners	.30	.42	.04	.....	.15	.20	.....	.....	.12	.05	.....	T.	.12	.....	.....	.04
Catskill	.....	1.38	.....	.....	.80	.....	.....	.15	1.10	.....	.....	.....	.....	T.	.....	.....
Cedar Hill	.42	.93	.....	.....	.24	.03	.....	T.	.62	T.	.....	.....	T.	T.	.....	.18
Greenwich	1.28	.82	.....	T.	.40	.....	.....	.....	.83	.03	.....	.06	.10	T.	.....	.10
Honeymead Brook	.54	.71	.....	.....	*	.67	.....	.....	.82	.....	.....	.....	.01	.....	.....	.03
Old Chatham	.43	.65	.....	.....	.10	.....	.....	.86	.....	.....	.....	.....	.....	.....	.....	.....
Red Hook	1.59	1.08	.....	.....	1.28	.....	.....	1.07	.....	.....	.....	.....	.....	.....	.....	.40
Spier Falls	.....	1.10	.....	.....	.60	.....	.....	.71	.....	.....	.....	.02	.11	.....	.....	.55
Wappingers Falls	.72	.68	.....	.....	1.10	.20	.....	.22	.62	.....	.....	.....	.....	T.	.....	.15
Canajoharie	.32	.59	T.	T.	1.40	.....	.....	.....	.39	.....	T.	.30	.08	.02	.....	.02
Little Falls 1	.37	.90	.08	.....	.14	.....	.....	.....	.18	.....	.27	.22	.04	.....	.....	T.
Rome	.80	1.44	.....	.....	.10	.20	.....	.....	.....	.....	.....	.20	.....	.....	.....	.33

T.—Trace, when precipitation is less than 0.01 inch. *Amount included in next measurement.

DAILY PRECIPITATION FOR NEW YORK, MARCH, 1902 — (*Continued*).

STATIONS.	DAY OF MONTH.															
	1.	2.	3.	4.	5	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
Champlain Valley:																
Caldwell	.40	1.10	T.	T.	.58	.05	.....	T.	.98	.....	.....	T.	.15	T.	.....	.42
Carvers Falls	.58	1.50	.....	.....	.....	.50	.....	.....	.20	.....	.....	.....	.....	.....	.....	.....
Glens Falls	.58	1.16	.....	.....	.60	.....	.....	.....	.75	.....	.....	.02	.....	.06	.....	.15
Saratoga Springs	.....	.98	.....	.....	.93	.....	.....	.....	.47	.....	.....	.....	.04	.....	.....	.10
Ticonderoga	.25	1.10	.....	.....	.18	.32	.....	.....	.47	.....	.....	.....	.....	.....	.....	.03
St. Lawrence Valley:																
De Kalb Junction	.70	.82	.21	.....	.....	.....	.06	.....	.25	.....	.11	.29	.11	.....	.....	.06
Moira	.41	1.03	.43	.....	.....	.....	.01	.....	.03	.....	.....	.68	.18	.....	.....	T.
North Hammond	.50	.77	.09	.....	.....	.....	.11	.....	.30	.....	.10	.28	.21	.....	.....	.12
Ogdensburg	.20	.45	.....	.....	.....	.....	.14	T.	.22	.....	.01	.37	.34	.....	.....	.04
Watertown	.55	.90	.15	.05	.....	.....	.....	.....	.39	.03	T.	.53	.40	.....	.....	.30
Great Lakes:																
Adams Center	.79	.93	.44	.....	.....	.....	.....	.....	.36	.02	.09	.17	.40	.....	.....	.28
Appleton	.....	.27	.05	.....	.....	.....	.....	T.	.....	.....	T.	T.	T.	.....	.....	.29
Baldwinsville	.55	.60	.03	.....	T.	.....	.....	.65	.06	.....	T.	.....	.19	.....	.....	.44
Brockport	.14	.17	.10	.....	.....	.....	.....	.....	.21	.....	T.	.19	.03	.....	.....	.17
Buffalo	.03	.20	.18	.01	T.	.....	.....	.01	.05	.....	.02	.10	.11	.....	.....	.28
Lyons	.....	.60	.05	.....	.....	.....	.....	T.	.60	.....	.....	.....	.....	.....	.....	.35
Oswego	.42	.85	.11	T.	.....	.....	.....	T.	.63	.....	T.	.04	.41	.....	.....	.48
Ridgeway	.09	.25	.14	.....	.....	.....	.....	T.	.13	.....	T.	.18	.08	.....	.....	.20
Rochester	.06	.19	.04	.....	.....	.....	.....	.03	.27	.....	.....	.03	.12	.....	.....	.08
Volusia	T.	.70	.11	.....	.....	.....	.....	.04	.23	.....	.04	T.	.17	.....	.....	.06
Westfield 3	.01	.10	.01	.....	.....	.....	.....	.06	.23	.....	.11	.05	.10	.....	.....	.08
Walcott	.47	.88	.10	.....	.....	.....	.....	.....	.55	.....	T.	.....	.20	.....	.....	*
Central Lakes:																
Auburn	.05	.75	.06	.....	.05	.....	.....	.....	.12	.....	T.	T.	.04	.....	.....	.50
Fayetteville	.19	.90	.10	.....	.44	.18	.....	.....	.37	.....	T.	.....	.13	.....	.....	.12
Ithaca	.17	.73	.21	T.	.34	T.	T.	T.	.29	.....	T.	T.	.02	T.	.....	.38
Kings Ferry	.34	.81	.20	.....	.40	.....	.....	.....	.38	T.	.....	.04	.03	.....	.....	.54
Penn Yan	.43	.43	T.	T.	.05	T.	.....	T.	.30	.....	T.	.....	T.	.....	.....	.30
[illegible]mulus	.16	.72	.14	.....	.10	.....	.....	T.	.40	.....	T.	.....	T.	.....	.....	.34
S[illegible]eateles	.32	1.25	.19	.02	.15	.....	.....	.10	.40	.....	.07	.05	.27	.....	.....	.27

T.—Trace, when precipitation is less than 0.01 inch. * Amount included in next measurement.

DAILY PRECIPITATION FOR NEW YORK, MARCH, 1902 —(*Continued*).

STATIONS.	DAY OF MONTH.															Total.
	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	
Western Plateau:																
Addison	.13	T.	T.	.....	.....	.....	.....	.....	.....	.....	T.	.30	.04	.03	.03	2.57
Akron	.12	.....	.....	T.	.....	.....	.....	.....	.....	.....	.03	.17	.29	.22	.09	1.89
Alden	T.	.10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.08	.44	.13	T.	1.46
Angelica	.15	T.	T.	.....	.....	.....	.....	.....	.....	.....	.05	.28	.15	.18	.15	2.53
Atlanta	.08	T.	.....	.....	.....	T.	.....	.....	.....	.....	.....	.15	.06	.07	.05	2.27
Avon	.10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.22	.14	T.	.07	1.58
Bolivar	.11	T.	T.	T.	.....	.....	.....	.....	.....	.....	T.	.18	.17	.18	T.	2.11
Elba	.....	.10	.....	.....	.....	.....	.....	.....	.....	.....	T.	.10	.20	.25	.07	1.52
Elmira	.....	.05	.....	.....	.....	.....	.....	.....	.....	.....	.....	.38	.03	.....	.....	2.63
Franklinville	.03	.03	T.	.....	.....	.....	.....	.....	.....	.....	.01	.21	.25	.15	.08	1.92
Hemlock Lake	.....	T.	T.	.....	.....	.....	.....	.....	.....	.....	.....	.20	.08	T.	.12	1.53
Humphrey	.05	.08	.01	.....	.....	.....	.....	.....	.....	.....	.....	.29	.40	.16	.09	2.55
Jamestown	.24	.01	T.	.....	.....	.....	.....	.....	.....	.....	.....	.20	.14	.18	.15	1.90
Nunda	.08	T.	.....	.....	.....	.....	.....	.....	.....	.....	.01	.10	.07	.07	.01	1.35
Shortsville	T.	T.	.....	T.	.02	.....	.....	.....	.....	.....	T.	.05	.26	.02	.....	1.98
South Canisteo	T.	.05	T.	T.	.....	T.	.....	.....	.....	.....	.33	.17	.03	.15	.05	2.73
Wedgewood	.21	.02	T.	T.	T.	.....	.....	.....	.....	.....	.25	.11	T.	.01	.....	2.87
Eastern Plateau:																
Binghamton	.31	.04	T.	T.	T.	.....	.....	.....	.....	.....	T.	.33	.08	.04	.10	3.54
Bouckville	.52	T.	.....	.10	.....	.....	.....	.....	.....	.....	.....	.....	.10	.....	.28	3.70
Cooperstown	.....	.05	.40	.....	.....	.....	.....	.....	.....	.....	.....	.27	.02	.10	.01	3.70
Cortland	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.35	.15	3.20
Griffins Corners	.61	.....	T.	.08	.....	.....	.....	.....	.....	.....	.....	.37	.39	.....	.03	3.39
Meredith	.64	T.	.09	T.	.....	.....	.....	.....	.....	.....	T.	.34	.33	.....	.21	4.14
Middletown	.30	.....	T.	.....	.....	.....	.....	.....	.....	.....	T.	.11	.65	T.	T.	3.72
Mohonk Lake	.70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.12	1.13	.....	.07	6.32
Newark Valley	.50	T.	T.	.....	.....	.....	.....	.....	.....	.....	T.	.44	.13	T.	.45	4.54
New Lisbon	.43	.....	.08	.10	.....	.....	.....	.....	.....	.....	.....	.19	.24	.....	.05	4.13
Oneonta	.57	.....	.17	.....	.....	.....	.....	.....	.....	.....	.....	.42	.....	.....	.15	3.45
Oxford	.70	T.	T.	T.	.10	.....	.....	.....	.....	T.	T.	.30	.22	T.	.11	4.32
Perry City (near)	.23	.10	.04	.....	T.	.....	.....	.....	.....	.....	T.	.20	.08	T.	.12	2.28
Port Jervis	.....	.....	.....	.01	.....	.....	.....	.....	.....	.....	.....	01	.69	.....	.01	3.23
Richmondville	.47	.....	.03	T.	.....	.....	.....	.....	.....	.....	.....	.....	.28	.....	.16	3.54
Salisbury Mills	.60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.28	.....	.....	3.59
South Kortright	.43	T.	.06	.20	.07	.....	.....	.....	.....	.....	.....	.30	.28	.....	.10	3.28

T.—Trace, when precipitation is less than 0.01 inch.

DAILY PRECIPITATION FOR NEW YORK, MARCH, 1902 —(*Continued*).

STATIONS.	DAY OF MONTH.															Total.
	17.	18.	19.	20.	21.	22.	23	24.	25.	26.	27.	28.	29.	30.	31.	
Eastern Plateau—(continued):																
Straits Corners	.42	.05									T.	.47	.12	T.	T.	4.53
Walton	.57	.02		.20								.30	.33		.10	3.76
Warwick	18											.22	.08		.10	3.97
Waverly	.57	T.	T.	T.							.10	.44	.15		.20	4.52
West Berne	T.												T.			2.50
Windham	.77	T.	.02								T.	.47	.22	.02	.12	4.00
Northern Plateau:																
Axton	.65	.02	.15	.04	.03						.07		.40		.11	4.68
Gabriels	.76		.10	.20	.08						.09	T.	.16	.03	.06	3.98
Ganseveort	.35		.20										1.10	.20	.10	6.28
Indian Lake	.40		.10								T.		.42		T.	1.65
Jay	.50		.05													1.93
Keene Valley	1.10	T.	.30	.12	.41	.01					.01		1.05	.01	.07	6.58
Little Falls 2	.70												.65			2.85
Lowville	.83	.02											.40			4.89
North Lake	1.00			T.	T.								1.01		.25	5.97
Number Four	.50	.50	.50	T.							T.		.23	.04	.64	6.30
Saranac Lake	.50	T.	.25	.25	.23	.01					.02	.02	.04	.05	.09	2.46
Speculator			.13										.36			3.55
South Schroon	.95		.33	T.							.07		.69		.06	5.64
Atlantic Coast:																
Bedford	.37	T.	T.	.02								.20	1.61	T.	.10	4.33
Cutchogue	.65		.20	T.								T.	1.27		.08	6.74
New York City	.23		T.									.14	.64	T.	.02	4.32
Primrose	.38		T.									.28	.78	T.	T.	4.85
Setauket	1.00		.01	.02								.03	1.20	.03	.03	5.85
Southampton	.65		.10		.07							.06	1.22		.05	6.09
Hudson Valley:																
Albany	.40	T.	.06	T.	.02						T.	.06	.24	.01	.04	3.24
Athens	.56	T.	T.	T.							T.	.24	.82		.22	5.60
Canaan Four Corners	.74		.08		.05							.08	90	.03	.15	3.47
Catskill	.98			T.									1.08	.24	T.	5.73
Cedar Hill	.55		.06	T.								.09	.10		.03	3.25
Greenwich	.35	T.	.15	.07	.38						T.	T.	1.12	.10	.16	5.95

Honeymead Brook	.23		.15								.02	.03	.70		.05	3.96
Old Chatham	.35			.10	.10								.50	.05	.15	3.99
Red Hook												.94				6.36
Spier Falls		T.	.12	.09							T.		1.20	.03		4.53
Wappingers Falls	.68		.05									.10	.52	T.	T.	5.04
Mohawk Valley:																
Canajoharie	.28	.01	.12	.02	.02						.02	.01	.28		.16	4.04
Little Falls 1	.49		T.	.14							T.		T.		.40	3.23
Rome	.83												.50			4.40
Champlain Valley:																
Caldwell	.79	T.	.36	.10	.09						T.	T.	.79		.11	5.92
Carvers Falls	.51		.30	.56									.63		.26	5.04
Glens Falls			.29	1.02	.18								1.38		.28	6.47
Saratoga Springs			.14	T.									1.10		.47	4.23
Ticonderoga	T.		.12	.04	.17								.40		.04	3.12
St. Lawrence Valley:																
De Kalb Junction	.35			.27	.20						.01		.43	.04		3.91
Moira	.34		T.	.02	.33						.14		.33	T.		3.93
North Hammond	.65	T.		.04	.05	.06					.01	.01	.45		.05	3.80
Ogdensburg	.70	T.		T.	T.								.50	.02		2.99
Watertown	.39				T.								.20	.04		3.93
Great Lakes:																
Adams Center	.58				.12								.12			4.30
Appleton	T.	T.	T.								T.	.09	.22	.34	.05	1.31
Baldwinsville		.10		.02							T.	.35		.08	T.	3.07
Brockport	.06	.08									T.	.08	.40	.21	T.	1.84
Buffalo	.06	.03	.04								T.	.06	.39	.22	.02	1.81
Lyons	.05	T.		T.	T.						T.	.12	T.	.28	T.	2.05
Oswego	.28	.08		.04	.02						T.	.02	.33	T.	.09	3.80
Ridgeway	T.	.09		T.	T.						.06	.04	.26	.23	.09	1.84
Rochester	.07	.05	T.	T.	T.						T.	.15	.31	.08	T.	1.48
Volusia	.04	.01									T.	.19	.04	.18	T.	1.81
Westfield 3	T.	.01									T.	.06	.04	.14		1.00
Walcott	.92	.05	.05		T.						T.	.40		T.	.10	3.52
Central Lakes:																
Auburn	.03	T.			.02						T.	.02	T.	T.		1.64
Fayetteville	.40	T.		.05	.05						T.		.09			3.02
Ithaca	.20	.06	T.	.01	T.	T.					T.	.41	.02	T.	.20	3.04
Kings Ferry	T.	.06		.05	T.							.09	.13		.05	3.12
Penn Yan	.05	T.	T.	T.	T.						T.	.16	.20	.03	T.	1.95
Romulus	T.	T.	T.									.11			.20	2.17
Skaneateles	.62	.12	T.		.07						T.	T.	.23			4 13

T.—Trace when precipitation is less than 0 01 inch.

Exhibit No. 13.

Report for July, 1902.

CLIMATE AND CROPS.

The month was unusually rainy, and excessive rains were general, except in the extreme southeast and in the extreme northwest sections, causing great damage by floods in the western plateau and in parts of central and eastern New York, but the most severe destruction was in Steuben, Chemung and Allegany counties and in the Genesee Valley. As a result of heavy rains and continued wet weather, many fields of crops were either washed away or abandoned, and corn and beans generally were rendered poor and backward. The harvest of wheat, hay and rye was much delayed, and great quantities ruined by the rains. Oats and barley were unusually heavy, but some lodging was reported. Buckwheat made fair progress, but the acreage was small, as it was not possible to sow many fields on account of rains. Grapes and potatoes were generally promising until near the end of the month, when more or less rot was reported. Reports as to winter apples varied greatly, some correspondents, chiefly in eastern and northern New York, estimating the crop to be good, and many others light. But the general outlook pointed to a light crop of apples, a very light supply of peaches and pears, and a poor crop of hops. While some improvement in crop conditions was noted near the close of July, the month, as a whole, was generally very unfavorable for farm operations and for the growth of crops.

TEMPERATURE.

July temperature differed but slightly from the average for this month, the mean, as determined from the records of 97 stations, being 68.3°, or 0.6° cooler than the average July. The

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maximum for the month was 99° on the 8th at Lyons, and the lowest was 34° at Axton on the 11th. The highest local mean was 73.5° at New York city, and the lowest local mean was 60° at Adirondack Lodge. The month was marked by cool nights, moderately warm days, and by a lack of unusual extremes, except on the 11th, when a minimum of 34° was recorded at Axton. The same station shows a minimum of 36° on the 12th. Maximum temperatures of 90° or slightly higher were reported at a few stations on the 5th, 7th, 8th, 9th, 14th, 15th, 17th, 27th, 28th, 30th and 31st. The mean for the month was about 70° on Long Island, as compared with 60° to 65° in the Adirondacks, 64° to 68° in the Catskills, and about 67° in Cattaraugus and Allegany counties.

The average temperature for each July in New York during the last 14 years is given in the following table:

1889	69.4
1890	68.6
1891	65.4
1892	69.2
1893	68.9
1894	70.9
1895	66.8
1896	70.4
1897	72.1
1898	72.2
1899	7.3
1900	70.6
1901	73.0
1902	68.3

PRECIPITATION.

Rains were very frequent, and the total monthly amounts unusually large, and phenomenally excessive in the greater portion of the western plateau and in parts of central and eastern New York. The average for the State, 6.77 inches, determined from records of 117 stations, which is 3.01 inches

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more than the normal July precipitation, has been exceeded in July but once, and that was in 1897, with a State average of 6.81 inches, or just 0.04 inch greater than the average for July, 1902. The largest monthly total was 12.46 inches at Angelica, and among other phenomenally large amounts are Arcade 10.51, Atlanta 10.21, Bolivar 10.87, Elba 9.76, Franklinville 10.09, Humphrey 9.68, Jamestown 9.12, Cooperstown 9.17, Nunda 9.93, Wedgewood 9.23, Cortland 10.12, Mohonk Lake 9.75, New Lisbon 10.08 and Perry City 9.46 inches. Amounts of 8 inches or more fell over the greater portion of the western plateau and in a considerable section of eastern New York and in parts of the central lake region. But for light rain on Long Island and in the vicinity of New York city, where the total monthly fall was 3.0 inches or less, and in the St. Lawrence Valley and in a small section of the northern plateau, where similar or smaller amounts are reported, the average for the State would have been by far the heaviest on record. The smallest amount at any one station was 1.68 inches at Ogdensburg. Rains were general on the 1st, 3d, 5th, 6th, 7th, 8th, 9th, 10th, 15th, 17th, 18th, 19th, 20th, 21st, 22d, 24th, 25th, 27th, 28th and 29th, and light scattered showers fell on the 2d, 4th, 11th, 14th, 16th, 23d and 26th. Angelica reports a rain of 4.50 inches on the 6th, and Elba 4.10 inches on the same date. For daily amounts at the several stations and the distribution throughout the month, see pages 7 and 8 of this bulletin.

The average rainfall for each July during the last 14 years in New York State is given in the following table:

1889	[illegible]
1890	3.33
1891	4.54
1892	4.56
1893	3.29
1894	[illegible]
1895	3.12
1896	4.90
1897	6.81
1898	3.17

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1899	3.72
1900	4.10
1901	4.28
1902	6.77

FLOODS.

The floods of July, 1902, are reported to be among the most severe ever felt in New York, and did great damage to agricultural interests and to railroad property. The following are a few of the remarks of observers in this connection:

Kings Ferry.— Most severe flood ever felt here occurred July 20th, washing away bridges and crops.

Elba.— Severe floods, ruining 75 per cent. of bean crop.

South Canisteo.—Storm of 26th most severe ever known in this section. Great damage to bridges and crops.

Penn Yan.— Rain for July, 9.04; heaviest on record, causing severe floods.

Wellsville.— The worst flood ever known in this section; impossible to estimate damage to crops and railroad property. Rainfall in places over 12 inches during month, and causing floods throughout Genesee Valley.

Alden.— Crops much damaged by excessive rains.

Arcade.— Flood morning of 6th greatest on record; water rose 8 to 10 feet in 20 minutes.

Angelica.—Flood morning of July 26th greatest on record; water 5 feet higher than at time of Johnstown flood. Houses destroyed and animals drowned. Nearly all bridges destroyed.

Avon.— Damage by floods in Genesee Valley several hundred thousand dollars.

Cooperstown.— Heaviest July rainfall in 48 years. Otsego Lake higher than ever known.

Fayetteville.— Probably one-third of corn ruined by water.

Franklinville.— Floods swept away crops and bridges and damaged roads. Loss immense.

New Lisbon.— Crops damaged by floods.

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LATE REPORTS FOR JUNE, 1902.

Adams Center.— Total precipitation for June, 1902, 5.87 inches.

Liberty.— Mean temperature, 61.8; total precipitation, 5.44 inches.

GENERAL SUMMARY FOR JULY, 1902.

TEMPERATURE.

	Degrees
Mean temperature (determined from records of 97 stations)	68.3
Departure from normal	—0.6
Highest local monthly mean (at New York city)	73.5
Lowest local monthly mean (at Adirondack Lodge)	60.0
Highest temperature (at Lyons, on 8th)	99
Lowest temperature (at Axton, on 11th)	34

PRECIPITATION.

Average precipitation (determined from records of 117 stations)	6.77
Departure from normal	+3.01
Greatest amount recorded at any station (at Angelica),	12.46
Least amount recorded at any station (at Ogdensburg),	1.58
Average number of days on which 0.01 inch or more fell	16

WIND.

Prevailing wind direction	SW.

WEATHER.

Average number of clear days	10
Average number of partly cloudy days	11
Average number of cloudy days	10

MISCELLANEOUS PHENOMENA (DATES OF).

Fogs.— 2, 4, 12, 13, 14, 19, 20, 21, 22, 23.

Frosts.— None.

Hail.— 5, 6, 7, 15, 17, 21, 22, 23, 24, 27, 28.

Lunar Coronae.— 14.

Solar Halos.— 2, 3, 9, 13, 14, 18, 31.

Thunderstorms.— On the 2d, at 1 station; 3, 2; 4, 5; 5, 34; 6, 19; 7, 21; 8, 12; 9, 17; 10, 3; 12, 1; 13, 1; 14, 16; 15, 40; 16, 3; 17, 33; 18, 9; 19, 11; 20, 23; 22, 5; 23, 14; 24, 40; 25, 3; 26, 5; 27, 28; 28, 22; 29, 6; 30, 7; 31, 12.

ATMOSPHERIC PRESSURE, RELATIVE HUMIDITY, AND WIND FOR JULY, 1902.

STATIONS.	BAROMETER, IN INCHES.					Mean relative humidity, per cent.	WIND.			
	Mean.	Maximum.	Date.	Minimum.	Date.		Total movement, miles.	Maximum velocity, miles.	Direction.	Date.
New York	30.00	30.27	7	29.74	15	73	7,996	52	w.	15
Albany	29.99	30.25	7	29.71	15	76	4,924	32	nw.	15
Binghamton	29.98	30.25	2	29.74	21	.....	3,496	25	sw.	3
Rochester	29.98	30.25	2	29.73	3	76	5,330	30	w.	7
Buffalo	30.00	30.25	2	29.72	21	77	8,365	45	sw.	3
Oswego	29.96	30.24	2	29.69	17	79	5,692	28	nw.	7
Erie, Pa	30.00	30.25	2	29.75	21	.....	6,339	30	w.	17
Ithaca	30.04	30.30	2	29.77	21	79	3,614	27	w.	17

SUPPLEMENTAL TABLE, JULY, 1902.

STATIONS.	Total precipitation.	Mean temperature.	Observers.
Adams Center	5.70	.....	A. E. Cooley.
Akron	6.82	.....	H. A. Wilder.
Blue Mountain Lake	7.20	.....	B. F. Merwin.
Boyds Corners	3.81	.....	Thomas Manning.
Browns Station	5.86	.....	E. Burhans.
Canaan Four Corners	8.47	66.0	W. W. Mayo.
De Kalb Junction	2.72	.....	C. A. Hallegas.
Easton	7.77	.....	H. Taber.
Gansevoort	6.43	.....	R. E. Cronkhite.
Haskinville	9.27	.....	Walter G. Collins.
Kings Ferry	7.81	.....	L. A. Goodyear.
Liberty	6.83	64.8	D. H. Clements.
Lyndonville	6.26	.....	Milton St. John.
Newark Valley	7.70	.....	M D. Clinton.
Nunda	9.93	70.4	B. E. Jones.
Ogdensburg	1.58	.....	Dr. Wm. Mabon.
Old Chatham	8.89	.....	Hugh Van Alstyne.
Red Hook	6.70	.....	E. S. Webber.
Salisbury Mills	5.09	.....	H. P. Ramsdell.
Scottsville	6.67	.....	Miss Florence Budlong.
Skaneateles	5.92	.....	Edward Conron.
S. E. Reservoir	4.74	.....	Thomas Manning.
Speculator	6.78	.....	Lyman Slack.
Spier Falls	5.44	68.1	Geo. E. Evans.
Warwick	6.58	.....	John W. Sly.

AVERAGE HOURLY WIND MOVEMENT FOR JULY, 1902.

STATION.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	12 noon.
Albany	4.6	4.6	4.6	4.8	4.7	4.7	5.7	6.7	8.0	8.5	8.7	8.5
Buffalo	9.0	9.4	10.3	10.2	10.4	10.8	11.0	11.4	11.4	11.8	12.6	13.1
Ithaca	4.1	4.8	4.3	4.5	4.8	4.9	4.3	4.5	4.7	5.0	5.3	5.5
New York City	8.7	8.6	8.6	8.3	8.8	8.5	9.5	10.0	10.2	10.9	11.9	11.5
Northfield, Vt	5.9	5.6	5.3	5.0	5.0	4.6	5.2	6.6	9.1	9.7	10.6	11.2
Oswego	7.4	7.6	7.6	7.5	7.7	7.6	8.2	8.5	9.1	9.3	9.5	9.0
Rochester	5.7	5.9	6.1	6.1	6.3	6.0	6.2	7.4	8.2	7.7	7.7	8.4

PREVAILING HOURLY WIND DIRECTION.

Albany	s.	s.	s.	s.	s.	s.	s.	se.	s.	s,se.	s.	s.
Binghamton	w.	e,nw.	nw.	e.	e.	w.	w.	w.	w.	w.	w.	w.
Buffalo	sw.	sw.	sw.	sw.	sw.	sw.	sw.	sw.	sw.	sw.	sw.	sw.
Ithaca	se.	se.	se.	se.	se.	se.	e,se,s.	se.	sw.	nw.	nw.	nw.
New York City	sw.	sw.	sw.	sw.	sw.	sw.	w.	sw.	nw.	nw.	†	†
Rochester	sw.	sw.	sw.	sw.	sw.	sw.	sw.	sw.	w.	sw.	w.	sw.

†SW, NW

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AVERAGE HOURLY WIND MOVEMENT FOR JULY, 1902 — (*Continued*).

STATION.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	12 midnight.	For the month.
Albany	9.1	8.8	8.8	8.8	8.5	7.7	6.4	5.7	5.7	5.2	5.1	4.7	6.6
Buffalo	13.1	14.5	13.8	13.1	14.3	12.6	10.9	10.0	9.4	9.2	9.1	8.4	11.2
Ithaca	6.0	5.9	6.0	6.5	6.2	5.3	4.8	4.4	4.3	4.5	3.9	4.0	4.9
New York City	12.3	12.0	12.2	12.5	12.4	12.1	12.9	12.8	12.9	11.8	9.8	8.9	10.7
Northfield, Vt	11.5	10.4	10.3	10.3	10.5	9.8	7.6	6.0	6.6	5.7	6.1	6.2	7.7
Oswego	8.7	8.5	8.3	7.5	7.6	6.4	6.5	5.8	5.9	6.4	6.3	6.7	7.7
Rochester	9.6	9.3	9.3	9.2	9.2	8.2	7.0	5.6	5.6	5.8	5.6	5.9	7.2

PREVAILING HOURLY WIND DIRECTION — (*Continued*).

Albany	s.	s.	s.	se.	s,w.	se.	s.	s.	se.	s.	s.	s.	s.
Binghamton	w.	w.	sw.	n.	w.	sw,w.	sw.	n.	w.	*	se.	w.	w.
Buffalo	sw.	sw.	sw.	sw,w.	sw,w.	sw.	sw.	sw.	sw.	sw.	sw.	sw.	sw.
Ithaca	nw.	nw.	nw.	nw.	nw.	n,nw.	n.	se.	se.	se.	se.	se.	se.
New York City	s,nw.	s.	se.	se.	s.	s.	s.	s,nw.	s.	sw.	sw.	sw.	nw.
Rochester	w.	nw.	ne.	w.	ne.	ne,w.	nw.	w.	se,sw.	sw.	s,sw.	sw.	sw.

*N,SE,W, NW.

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CLIMATOLOGICAL DATA FOR NEW YORK, JULY, 1902.

STATIONS.	Counties.	Elevation, feet.	Length of record, years.	Temperature, in Degrees Fahrenheit.						
				Mean.	Departure from the normal.	Highest.	Date.	Lowest.	Date.	Greatest daily range.
Western Plateau:										
Addison	Steuben	1,000	12	70.6	+0.6	91	8	48	*2	38
Alden	Erie	.....	2	70.2	.....	88	7	50	*2	28
Angelica	Allegany	1,340	18	68.2	+0.3	95	10	43	2	42
Arcade	Wyoming	.....	.....	67.6	.....	86	7	43	19	30
Atlanta	Steuben	1,200	11	68.2	.....	87	*7	47	13	35
Avon	Livingston	585	7	70.0	.....	89	*7	51	2	31
Bolivar	Allegany	1,800	6	66.8	.....	88	6	42	*11	39
Elba	Genesee	500	2	68.6	.....	88	6	51	*1	26
Elmira	Chemung	863	22	72.6	+0.4	92	*8	51	23	37
Franklinville	Cattaraugus	1,598	5	67.4	.....	86	6	42	11	34
Hemlock Lake	Livingston	900	3	70.8	.....	86	*7	52	1	25
Humphrey	Cattaraugus	1,950	18	66.8	—1.5	84	*6	43	11	31
Jamestown	Chautauqua	1,328	6	70.0	.....	89	27	45	11	37
Lockport	Niagara	650	16	69.9	.....	86	*6	51	1	26
Shortsville	Ontario	740	2	69.6	.....	88	*7	52	1	28
South Canisteo	Steuben	1,480	12	67.9	—0.8	89	14	44	*2	39
Wedgewood	Schuyler	1,430	12	68.6	—1.7	87	8	50	10	26
Eastern Plateau:										
Binghamton	Broome	875	11	69.2	—0.8	87	14	50	17	36
Bouckville	Madison	1,350	4	67.0	.....	87	14	48	17	31
Cooperstown	Otsego	1,250	48	66.2	—2.0	84	14	47	17	28
Cortland	Cortland	1,130	41	68.8	+2.0	88	15	45	1	32
Griffins Corners	Delaware	2,260	2	64.2	.....	84	14	39	17	36
Meredith	Delaware	2,260	1	64.4	.....	82	9	43	17	31
Middletown	Orange	700	11	70.8	—1.9	90	9	54	17	26
Mohonk Lake *b*	Ulster	1,245	6	67.7	.....	84	9	51	17	24
New Lisbon	Otsego	1,234	11	64.8	—1.2	85	8	41	17	37
Oneonta	Otsego	1,100	6	68.2	.....	88	*9	46	11	34
Oxford	Chenango	958	38	67.3	—1.1	85	*8	47	*2	33
Perry City (near)	Schuyler	1,038	12	68.8	0.0	89	14	48	*17	36
Port Jervis	Orange	470	17	70.6	0.0	1	.....	48	17	32
Richmondville	Schoharie	500	3	67.3	.....	85	*8	42	17	36
South Kortright	Delaware	1,441	13	65.4	—0.8	86	14	40	17	36

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Straits Corners *b*	Tioga	600	5	68.8	.....	89	14	47	*3	38
Walton	Delaware	.....	1	66.5	.....	87	14	43	*2	38
Waverly	Tioga	824	20	71.8	+1.8	91	*8	45	11	40
West Berne	Albany	600	3	66.5	.....	87	14	42	17	38
Windham	Greene	1,520	2	67.0	.....	92	9	40	17	40
Northern Plateau:										
Adirondack Lodge	Essex	2,224	.....	60.0	.....	79	9	10	17	32
Axton	Franklin	1,600	2	63.0	.....	86	30	34	1	40
Gabriels	Franklin	1,800	2	63.0	.....	85	31	42	*11	35
Gloversville	Fulton	850	10	67.2	.....	87	[illegible]	46	17	33
Harkness	Clinton	622	.....	68.8	.....	89	[illegible]	47	2	30
Indian Lake	Hamilton	1,705	2	63.0	.....	85	*8	35	12	37
Keene Valley	Essex	1,000	5	65.6	.....	90	8	40	17	37
Little Falls 2	Herkimer	1,526	5	66.7	.....	87	14	43	17	34
Lowville	Lewis	900	36	67.3	—0.4	87	30	47	2	31
Number Four	Lewis	1,751	13	63.6	—0.9	81	8	42	2	..
Saranac Lake (near)	Essex	1,750	8	64.9	.....	86	8	42	17	45
South Schroon	Essex	1,225	1	64.3	.....	87	8	41	17	32
Wells	Hamilton	850	.....	65.1	.....	88	8	39	17	39
West Chazy	Clinton	.....	4	67.2	.....	90	8	47	1	32
Atlantic Coast:										
Bedford	Westchester	290	8	70.5	.....	.....	8	46	17	32
Cutchogue	Suffolk	32	3	69.8	.....	89	9	51	17	25
New York City	New York	314	31	73.5	0.0	91	9	61	11	25
Primrose	Westchester	200	5	72.0	.....	96	9	48	17	35
Setauket	Suffolk	40	16	70.2	—1.8	88	9	52	17	23
Southampton	Suffolk	.....	1	68.8	.....	84	5	52	7	25
Hudson Valley:										
Albany	Albany	97	74	70.4	—2.0	92	9	53	17	28
Athens	Greene	.....	.....	69.4	.....	89	14	51	17	27
Carmel	Putnam	500	10	70.0	—2.6	91	14	48	17	33
Cedar Hill	Albany	208	3	69.0	.....	91	9	48	13	38
Greenwich	Washington	425	4	67.6	.....	86	14	46	17	30
Honeymead Brook	Dutchess	450	21	68.6	—1.5	87	9	47	17	28
Wappingers Falls	Dutchess	110	9	69.5	.....	88	*9	49	3	26
Mohawk Valley:										
Canajoharie	Montgomery	300	5	67.2	.....	85	*8	46	17	33
Little Falls 1	Herkimer	924	5	67.0	.....	87	14	50	17	30
Rome	Oneida	445	12	69.2	0.0	89	*14	50	*2	30
Champlain Valley:										
Caldwell	Warren	350	5	66.6	.....	88	4	47	17	31
Carvers Falls	Washington	243	4	66.4	.....	87	8	47	7	30
Glens Falls	Warren	340	10	69.0	.....	89	*8	47	1	30

* Also on subsequent dates. *a*, *b*, *c*, etc., indicate number days missing from reports.

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CLIMATOLOGICAL DATA FOR NEW YORK, JULY, 1902—(*Continued*).

STATIONS.	Counties.	Elevation, feet.	Length of record, years.	TEMPERATURE, IN DEGREES FAHRENHEIT.						
				Mean.	Departure from the normal.	Highest.	Date.	Lowest.	Date.	Greatest daily range.
Champlain Valley—(Continued):										
Plattsburg	Clinton	125	32	68.8	0.7	94	.....	50	*2	43
Saratoga Springs	Saratoga	314	5	68.3	.....	91	30	48	12	40
Ticonderoga	Essex	128	4	66.6	.....	86	8	52	*1	24
St. Lawrence Valley:										
Canton	St. Lawrence	304	38	67.6	—2.9	87	31	46	2	26
Moira	Franklin	800	2	68.3	.....	88	31	48	2	32
North Hammond	St. Lawrence	420	23	69.9	—2.1	86	*30	52	*16	24
Watertown	Jefferson	486	9	70.4	.....	88	*30	51	2	30
Great Lakes:										
Appleton	Niagara	270	13	69.4	—0.3	91	7	49	1	28
Baldwinsville	Onondaga	385	23	70.4	+0.1	89	14	54	*1	29
Brockport	Monroe	537	2	70.6	.....	92	7	52	*1	27
Buffalo	Erie	768	42	69.7	0.0	85	31	53	1	17
Lyons *b*	Wayne	426	14	72.4	+1.9	99	8	54	11	33
Oswego	Oswego	335	31	67.7	—1.3	85	14	53	1	23
Palermo	Oswego	460	42	.....	.....	90	*7	52	12	38
Ridgeway	Orleans	.....	5	70.0	.....	88	7	51	1	23
Rochester	Monroe	523	31	70.9	+0.5	91	7	52	1	24
Volusia	Chautauqua	1,167	2	68.0	.....	85	7	49	11	24
Westfield 2	Chautauqua	867	3	69.6	.....	86	*7	52	1	23
Westfield 3	Chautauqua	568	3	70.2	.....	88	27	50	12	22
Wolcott	Wayne	.....	.....	69.8	.....	90	*8	52	*1	32
Central lakes:										
Auburn	Cayuga	715	39	70.7	+0.1	90	*8	50	11	31
Fayetteville	Onondaga	.....	3	70.1	.....	90	14	50	2	30
ITHACA	Tompkins	836	23	69.8	—1.6	88	14	52	*1	34
Penn Yan *d*	Yates	750	58	71.6	.....	90	14	53	1	28
Romulus	Seneca	719	11	69.8	—2.1	88	*8	48	1	29

* Also on subsequent dates. *a, b, c, etc.*, indicate number days missing from reports.

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CLIMATOLOGICAL DATA FOR NEW YORK, JULY, 1902 — (*Continued*).

STATIONS.	Counties.	PRECIPITATION, IN INCHES.					SKY.			Prevailing direction of wind.	Observers.
		Total.	Departure from the normal.	Greatest in 24 hours.	Total snowfall (unmelted).	Number rainy days.	Number clear days.	Number partly cloudy days.	Number cloudy days.		
Western Plateau:											
Addison	Steuben	6.85	+3.71	1.45	....	16	20	6	5	sw.	Dr. H. R. Ainsworth.
Alden	Erie	7.03	....	1.35	....	15	17	9	5	w.	Ira B. Hawthorne.
Angelica	Allegany	12.46	+9.01	4.50	....	21	9	13	9	w.	Prof. Edward Maguire.
Arcade	Wyoming	10.51	....	2.30	....	18	10	14	7	w.	L. E. Runals.
Atlanta	Steuben	10.21	+6.26	2.35	....	71	9	9	13	w.	F. D. Crouch.
Avon	Livingston	6.66	....	2.01	....	17	19	5	7	.....	Wm. G. Markham.
Bolivar	Allegany	10.87	....	1.84	....	20	2	21	8	sw.	Dr. Dorr Cutler.
Elba	Genesee	9.76	....	4.10	....	16	8	12	11	w.	Jos. S. Wilford.
Elmira	Chemung	7.84	+4.75	2.60	.....	16	15	11	5	nw.	Gerity Bros.
Franklinville	Cattaraugus	10.09	....	1.50	....	20	12	11	8	w.	Dr. John W. Kales.
Hemlock Lake	Livingston	8.73	....	2.44	.....	14	11	10	10	sw.	D. H. Westbury.
Humphrey	Cattaraugus	9.68	+5.33	1.84	.....	22	5	13	13	sw.	Charles E. Whitney.
Jamestown	Chautauqua	9.12	+4.25	1.78	.....	18	9	9	13	sw.	G. H. Anderson.
Lockport	Niagara	5.73	+2.11	1.06	.....	14	12	9	10	sw.	J. E. Wakeman.
Shortsville	Ontario	6.20	....	1.10	....	18	15	11	5	nw.	C. H. Latting.
South Canisteo	Steuben	8.40	+4.11	1.80	.....	16	10	14	7	w.	James. E. Wilson.
Wedgewood	Schuyler	9.23	+5.54	2.54	.....	21	13	14	4	nw.	O. F. Corwin.
Eastern Plateau:											
Binghamton	Broome	5.51	+2.55	1.11	.....	14	3	17	11	w.	U. S. Weather Bureau.
Bouckville	Madison	7.25	....	1.24	.....	19	4	10	17	nw.	L. W. Griswold.
Cooperstown	Otsego	9.17	+4.82	2.00	.....	17	6	12	13	s.	G. Pomeroy Keese.
Cortland	Cortland	10.12	+5.46	1.75	.....	18	3	23	5	n.	The Standard.
Griffins Corners	Delaware	7.93	.....	2.09	.....	20	9	10	12	w.	Sylvenus Kelly.
Meredith	Delaware	8.19	....	2.47	.....	21	9	14	8	se.	Wm. Waller.
Middletown	Orange	5.00	—0.56	1.11	.....	14	.....	.....	.....	nw.	M. C. Ashley.
Mohonk Lake *b*	Ulster	9.75	.....	4.05	.....	18	5	7	19	sw.	Albert K. Smiley.
New Lisbon	Otsego	10.08	+5.57	3.76	.....	19	2	11	18	s.	G. A. Yates.
Oneonta	Otsego	7.71	.....	2.58	.....	14	12	4	15	nw.	H. W. Lee.
Oxford	Chenango	8.65	+4.49	2.02	.....	18	3	22	6	sw.	John P. Davis.
Perry City (near)	Schuyler	9.46	+5.75	1.94	.....	19	6	15	10	w.	W. H. Jeffers.
Port Jervis	Orange	5.44	—0.28	0.94	.....	20	11	11	9	sw.	Prof. John M. Dolph.
Richmondville	Schoharie	6.95	.....	2.00	.....	16	13	8	10	w.	Miss Asenath France.

a, b, c, etc., indicates number days missing from reports.

CLIMATOLOGICAL DATA FOR NEW YORK, JULY, 1902 — (*Continued*).

STATIONS.	Counties.	PRECIPITATION, IN INCHES.					SKY.			Prevailing direction of wind.	Observers.
		Total.	Departure from the normal.	Greatest in 24 hours.	Total snowfall (unmelted).	Number rainy days.	Number clear days.	Number partly cloudy days.	Number cloudy days.		
Eastern Plateau (Continued):											
South Kortright	Delaware	6.36	+2.35	2.15	.....	19	12	6	13	sw.	S. W. Andrews.
Straits Corners *b*	Tioga	6.19	.....	1.40	.....	15	.....	.....	.....	s.	W. E. Elmendorf.
Walton	Delaware	8.80	.....	3.75	.....	17	7	13	11	sw.	Richmond Garrison.
Waverly	Tioga	7.29	+3.58	1.43	.....	17	4	14	13	w.	T. P. Yates.
West Berne	Albany	7.05	.....	1.43	.....	15	5	12	14	w.	E. B. Haverly.
Windham	Greene	7.44	.....	1.63	.....	16	5	19	7	.....	A. R. Mott.
Northern Plateau:											
Adirondack Lodge	Essex	7.63	.....	1.20	.....	18	9	9	13	w.	H. Van Hovenberg.
Axton	Franklin	4.60	.....	0.64	.....	11	3	15	13	w.	H. E. Barkley.
Gabriels	Franklin	3.34	.....	0.80	.....	17	15	5	11	sw.	A. C. Davis.
Gloversville	Fulton	7.38	+3.23	1.40	.....	15	11	5	15	w.	W. McLean.
Harkness	Clinton	3.93	.....	0.57	.....	17	21	3	7	w.	J. W. Harkness.
Indian Lake	Hamilton	8.31	.....	2.84	.....	15	12	8	11	sw.	Frank Pelon.
Keene Valley	Essex	5.27	.....	1.44	.....	18	12	7	12	nw.	Rev. John Irons.
Little Falls 2	Herkimer	8.44	.....	1.69	.....	14	7	3	21	w.	A. Ten Eyck Lansing.
Lowville	Lewis	7.37	+3.78	2.78	.....	15	8	18	5	w.	Charles J. Rice.
Number Four	Lewis	7.36	+2.39	1.65	.....	11	7	17	7	.....	Charles Fenton.
Saranac Lake (near)	Essex	3.22	.....	0.68	.....	17	2	23	6	s.	J. W. Harper.
South Schroon	Essex	6.04	.....	1.56	.....	17	9	9	13	s.	L. W. Whitney.
Wells	Hamilton	6.04	.....	1.42	.....	18	7	15	9	se.nw.	George Murray.
West Chazy	Clinton	.....	.....	.....	.....	.....	9	8	14	nw.	D. P. Harris.
Atlantic Coast:											
Bedford	Westchester	3.78	.....	1.04	.....	21	14	13	4	.....	Dr. Henry Herbert.
Cutchogue	Suffolk	2.28	.....	0.66	.....	12	10	17	4	sw.	Wm. A. Fleet.
New York City	New York	3.12	—1.14	0.88	.....	14	6	8	17	nw.	U. S. Weather Bureau.
Primrose	Westchester	5.23	.....	2.05	.....	12	4	21	6	.....	W. A. Cornelius.
Setauket	Suffolk	2.41	—2.46	1.28	.....	9	9	8	14	.....	Selah B. Strong.
Southampton	Suffolk	3.76	.....	0.96	.....	13	8	21	2	sw.	W. L. Jagger.
Hudson Valley:											
Albany	Albany	5.37	+1.41	1.68	.....	15	5	10	16	s.	U. S. Weather Bureau.
Athens	Greene	6.09	.....	1.65	.....	14	7	14	10	sw.	E. C. Brooks.

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Carmel	Putnam	5.21	.....	1.54	.....	14	13	5	13	sw.	Thomas Manning.
Cedar Hill	Albany	5.71	.....	2.39	.....	14	13	6	12	s.	Schoonmaker & Son.
Greenwich	Washington	6.67	.....	1.20	.....	13	8	11	12	sw.	Oscar W. Tefft.
Honeymead Brook	Dutchess	6.74	+1.19	2.25	.....	18	5	9	17	n.	Dr. James Hyatt.
Wappingers Falls	Dutchess	6.56	+1.43	2.14	.....	19	7	16	8	ne. se.	H. C. Townsend.
Mohawk Valley:											
Canajoharie	Montgomery	5.73	.....	1.13	.....	21	13	7	11	w.	J. E. Countryman.
Little Falls 1	Herkimer	9.07	.....	1.38	.....	17	12	10	9	w.	E. Ten Eyck Lansing.
Rome	Oneida	6.82	+2.26	1.54	.....	9	20	4	7	w.	W. H. Bingham.
Champlain Valley:											
Caldwell	Warren	6.76	.....	1.66	.....	14	8	7	16	s.	Galloway C. Morris.
Carvers Falls	Washington	3.95	.....	0.98	.....	7	11	12	8	.....	W. Fancher, C. E.
Glens Falls	Warren	6.43	.....	1.35	.....	13	4	10	17	s.	Prof. C. L. Williams.
Plattsburg	Clinton	4.30	+0.85	0.80	.....	13	5	16	10	se.	Post Surgeon.
Saratoga Springs	Saratoga	7.28	.....	1.80	.....	10	7	6	18	sw.	F. G. Burnham.
Ticonderoga	Essex	4.86	.....	0.91	.....	19	19	3	9	s.	George De Lano.
St. Lawrence Valley:											
Canton	St. Lawrence	.....	.....	.....	.....	.....	13	6	12	sw.	C. W. Bolton.
Moira	Franklin	4.61	.....	1.45	.....	12	16	9	6	w.	C. E. McBride.
North Hammond	St. Lawrence	2.02	—1.62	0.50	.....	14	15	8	8	w.	C. A. Wooster.
Watertown	Jefferson	3.48	.....	0.98	.....	15	20	5	6	sw.	H. P. Dunlap.
Great Lakes:											
Appleton	Niagara	8.26	+4.33	4.21	.....	14	11	14	6	ne.	H. A. Van Wagoner.
Baldwinsville	Onondaga	6.27	+2.32	1.25	.....	18	19	9	3	.....	S. C. Suydam.
Brockport	Monroe	4.93	.....	1.18	.....	15	11	15	5	sw.	W. H. Lennon.
Buffalo	Erie	4.53	+1.35	1.01	.....	19	6	13	12	sw.	U. S. Weather Bureau.
Lyons *b*	Wayne	6.77	+3.50	1.65	.....	16	.....	.....	.....	.....	Dr. M. A. Veeder.
Oswego	Oswego	6.48	+3.36	1.64	.....	17	13	9	9	s.	U. S. Weather Bureau.
Palermo	Oswego	6.00	+2.78	1.08	.....	16	8	14	9	w.	E. B. Bartlett.
Ridgway	Orleans	7.00	.....	2.13	.....	14	17	9	5	sw.	M. E. Weld.
Rochester	Monroe	4.43	+1.46	0.95	.....	17	9	11	11	sw.	U. S. Weather Bureau.
Volusia	Chautauqua	8.94	.....	1.98	.....	18	13	11	7	sw.	Benjamin Breads.
Westfield 2	Chautauqua	8.52	.....	1.73	.....	18	.....	.....	.....	.....	John R. Rogers.
Westfield 3	Chautauqua	8.35	.....	2.83	.....	15	9	15	7	sw.	D. H. Beadle.
Wolcott	Wayne	7.18	.....	1.57	.....	16	17	10	4	w.	L. W. Wayne.
Central Lakes:											
Auburn	Cayuga	7.48	+3.91	1.16	.....	17	18	11	2	nw.	A. H. Underwood.
Fayetteville	Onondaga	6.99	.....	1.75	.....	18	16	8	7	sw.	Dana H. Wells.
ITHACA	Tompkins	6.69	+3.01	1.00	.....	22	6	15	10	se.	SECTION CENTRE.
Penn Yan *d*	Yates	9.04	+5.86	1.67	.....	16	.....	.....	.....	sw.	Ralph L. Eastman.
Romulus	Seneca	9.25	+5.96	1.92	.....	18	9	15	7	w.	John H. Coryell.

NOTE. — Mean temperatures are derived from the daily extremes by the maximum and minimum thermometers. All records are used in determining State or district means, but State and district departures are determined by comparison of current date of only such stations as have normals.

a, *b*, *c*, etc., indicate number days missing from reports.

MAXIMUM AND MINIMUM TEMPERATURES FOR NEW YORK, JULY, 1902.

STATIONS.	1.		2.		3.		4.		5.		6.		7.		8.		9.		10.		11.		12.		13.		14.		15.		16.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Western Plateau:																																
Addison	76	55	79	48	82	59	87	62	88	65	87	65	82	68	91	68	86	59	76	65	80	48	82	59	84	50	89	56	85	61	75	55
Alden	69	51	78	50	73	64	83	68	83	71	85	66	88	70	85	67	83	65	72	62	74	50	79	56	79	55	84	68	76	67	74	62
Angelica	72	52	78	43	75	50	84	58	88	58	87	63	86	62	86	63	84	56	95	60	75	44	77	45	86	44	87	52	86	59	71	51
Arcade	71	45	75	67	77	57	81	63	83	65	85	62	86	64	83	58	85	61	70	43	74	46	75	46	79	56	84	63	77	53	73	54
Atlanta	72	52	79	49	74	62	83	59	83	62	83	64	87	66	86	64	82	60	71	56	77	51	76	49	82	47	87	57	81	57	70	54
Avon	73	52	80	51	74	62	85	59	83	63	85	74	89	69	87	67	85	63	74	55	78	51	79	53	84	53	89	64	83	66	75	51
Bolivar	73	51	80	43	76	55	83	56	85	61	88	64	82	60	86	61	81	53	77	61	77	42	78	44	81	42	86	49	81	47	73	50
Elba	70	51	75	51	70	64	80	60	80	64	88	66	86	70	84	67	80	64	70	61	75	52	80	54	79	59	82	66	80	63	74	54
Elmira	77	55	79	54	81	66	79	64	84	68	81	66	84	62	92	70	86	64	80	63	80	52	82	63	86	62	88	56	85	67	83	55
Franklinville	70	51	78	45	75	61	82	57	82	65	86	61	84	65	84	65	81	56	73	60	75	42	75	46	79	45	84	56	78	61	70	56
Hemlock Lake	72	52	78	55	79	62	82	66	84	66	84	68	86	70	86	76	83	66	75	60	76	54	77	58	80	60	85	68	80	68	70	57
Humphrey	68	54	76	55	71	61	79	59	82	63	84	64	84	65	83	61	81	55	75	53	74	43	74	49	77	47	82	57	78	62	69	52
Jamestown	73	52	78	55	75	55	83	65	86	68	88	68	86	65	85	64	80	57	72	62	78	45	78	48	83	46	87	55	83	63	75	55
Lockport	72	51	76	55	75	65	82	58	84	65	86	68	86	69	85	67	79	64	71	62	75	52	77	52	80	59	85	67	80	66	72	54
Shortsville	72	52	75	54	73	63	81	61	79	64	81	67	88	69	85	67	85	63	77	61	75	53	76	56	82	57	88	66	84	68	76	53
South Canisteo	73	49	79	44	70	55	86	58	82	62	87	62	86	66	87	62	84	59	79	50	80	50	78	44	83	44	89	53	84	59	74	49
Wedgewood	72	52	75	51	78	62	82	61	84	64	81	64	81	65	87	66	83	62	72	50	75	51	78	54	81	56	85	60	81	64	69	54
Eastern Plateau:																																
Binghamton	72	56	78	50	80	64	84	62	83	66	83	66	75	63	87	69	85	62	74	54	75	51	79	52	82	54	87	58	81	64	68	52
Bouckville	70	53	76	51	70	58	79	57	81	64	77	63	75	56	85	65	85	60	72	60	75	50	79	52	82	51	87	60	81	59	70	52
Cooperstown	68	55	72	51	74	59	77	62	80	65	74	64	74	58	82	65	82	62	71	55	70	50	76	50	79	53	84	58	79	65	63	52
Cortland	71	45	78	50	78	61	84	65	80	63	83	55	81	61	87	61	87	60	81	62	76	51	78	50	82	50	87	56	88	63	83	55
Griffins Corners	68	52	74	45	74	51	77	57	79	58	73	62	69	53	81	63	82	53	77	61	71	42	76	42	78	46	84	50	78	56	68	52
Meredith	65	51	70	49	73	55	74	57	73	62	73	62	70	54	80	62	82	60	75	59	69	47	74	47	75	52	80	55	80	60	70	52
Middletown	73	57	78	58	79	63	82	64	86	76	77	65	72	58	85	67	90	70	80	64	78	58	78	57	83	62	89	63	85	70	74	61
Mohonk Lake	70	...	73	...	76	58	78	62	83	65	69	61	68	55	82	64	84	66	80	66	73	55	72	59	77	63	83	68	80	65	70	53
New Lisbon	71	50	73	46	77	53	81	57	82	60	77	62	72	54	85	63	82	55	72	52	74	42	77	43	80	45	84	50	78	58	67	50
Oneonta	74	55	79	47	78	58	83	60	83	63	81	65	73	61	88	66	88	62	77	57	79	46	80	47	83	50	88	54	84	63	70	58
Oxford	71	55	76	47	77	57	72	60	83	63	79	65	75	57	85	65	83	60	72	63	75	48	77	48	81	50	85	53	81	62	70	53
Perry City (near)	74	50	78	53	78	60	85	58	83	61	83	63	86	64	88	65	85	60	74	60	77	54	79	50	83	49	89	57	82	61	71	58
Port Jervis	73	59	80	51	80	59	84	62	89	66	80	66	73	59	87	68	91	65	78	65	79	50	82	52	85	58	90	58	89	62	74	59
Richmondville	71	53	77	54	77	58	80	60	82	62	74	61	72	57	85	67	84	63	84	61	73	51	77	47	81	51	85	58	80	63	67	54
South Kortright	70	54	75	42	77	53	79	54	80	62	75	63	70	56	84	64	85	55	76	57	72	42	76	46	80	45	86	59	90	60	68	54
Straits Corners	72	53	...	...	82	47	84	60	85	60	83	65	85	63	88	60	82	59	...	...	82	55	78	48	81	48	80	54	82	60	70	55
Walton	70	54	78	43	78	61	81	63	83	60	80	65	72	53	85	55	84	57	77	61	74	45	78	44	82	50	87	51	81	58	66	51

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MAXIMUM AND MINIMUM TEMPERATURES FOR NEW YORK, JULY, 1902—(*Continued*).

STATIONS.	1.		2.		3.		4.		5.		6.		7.		8.		9.		10.		11.		12.		13.		14.		15.		16.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Great Lakes:																																
Appleton	77	49	75	52	72	61	79	57	82	62	82	62	91	63	89	67	83	64	72	62	76	52	79	53	84	57	90	65	82	65	78	58
Baldwinsville	73	54	78	54	79	62	81	60	84	65	84	67	85	62	88	67	85	62	76	63	78	54	79	55	84	56	89	65	83	64	73	56
Brockport	76	52	79	55	77	62	83	60	82	64	85	66	92	69	87	69	85	63	73	62	79	53	81	52	83	59	87	65	83	65	70	53
Buffalo	62	53	75	59	74	63	79	62	72	66	76	67	80	70	76	68	78	68	70	62	72	62	74	62	75	66	76	72	78	61	70	56
Oswego	65	53	70	53	70	55	75	56	74	61	78	63	83	64	83	68	79	62	67	60	70	57	75	57	82	59	85	66	76	62	65	57
Ridgeway	74	51	76	55	74	63	80	60	79	70	83	66	88	72	86	70	79	66	71	63	76	60	77	55	80	60	85	67	80	67	71	57
Rochester	75	52	78	56	73	65	82	61	79	65	84	67	91	69	88	70	82	66	73	59	75	54	78	58	83	59	89	67	81	62	71	56
Volusia	66	50	74	50	71	64	81	61	79	70	83	72	85	68	81	66	81	61	71	56	68	49	70	52	76	53	82	64	75	63	69	54
Westfield 2	67	52	75	53	73	65	81	63	82	67	84	72	86	70	63	69	82	62	72	60	72	53	77	54	78	57	82	65	75	64	72	56
Central Lakes:																																
Auburn	77	53	80	52	72	62	85	60	83	64	86	66	85	65	90	66	85	63	75	57	80	50	81	55	84	55	90	64	85	67	75	53
Fayetteville	70	54	77	50	72	63	83	62	83	70	84	65	80	62	89	62	87	63	76	62	77	51	80	56	85	55	90	64	83	64	72	56
Ithaca	72	52	78	52	77	62	84	62	80	65	81	66	80	65	87	70	84	64	71	55	86	52	87	54	82	53	88	64	82	64	68	53
Penn Yan	74	53	81	58	79	63	...	...	...	...	83	66	85	70	88	69	85	65	...	...	...	...	80	56	85	59	90	66	83	69	72	56
Romulus	73	48	78	55	76	62	2	61	82	65	81	65	85	65	88	68	85	69	73	63	78	52	80	55	83	61	88	60	72	64	73	55

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MAXIMUM AND MINIMUM TEMPERATURES FOR NEW YORK, JULY, 1902—(*Continued*).

STATIONS.	17.		18.		19.		20.		21.		22.		23.		24.		25.		26		27.		28.		29.		30.		31.		MONTHLY MEAN.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Western Plateau:																																
Addison	89	51	79	62	78	60	76	56	80	61	70	60	83	50	77	57	80	52	83	61	90	64	85	65	80	66	85	63	86	65	82.3	58.9
Alden	80	62	76	60	74	62	66	60	72	62	73	57	73	57	72	60	80	62	84	68	86	64	78	67	82	64	84	60	87	63	78.5	61.9
Angelica	83	50	75	57	74	58	76	58	78	59	71	54	81	47	77	56	82	50	85	59	87	59	82	62	76	60	84	62	85	61	81.1	55.2
Arcade	80	57	69	59	74	63	75	60	71	56	72	47	77	47	76	52	78	53	83	62	83	63	80	60	79	58	82	57	83	66	78.4	56.9
Atlanta	82	53	70	57	72	58	70	59	77	63	70	55	81	49	79	49	79	49	85	60	87	64	81	64	79	60	85	63	86	63	79.2	57.3
Avon	84	56	80	60	70	60	65	59	76	60	74	57	81	54	79	60	79	53	85	62	87	65	79	66	83	63	84	60	88	61	80.5	59.6
Bolivar	83	47	70	56	77	59	75	63	74	60	70	54	79	44	75	53	79	49	82	56	85	57	80	60	79	62	84	60	83	61	79.4	54.2
Elba	81	59	75	61	64	60	62	59	67	60	72	58	75	59	76	60	76	56	77	62	82	64	78	64	78	63	81	59	85	63	76.8	60.4
Elmira	90	53	83	65	78	60	80	62	81	64	76	59	87	51	80	61	80	55	84	63	91	65	87	67	82	65	92	66	88	66	83.5	61.6
Franklinville	81	52	72	59	74	61	72	65	70	60	71	55	76	49	75	57	80	52	82	59	85	62	78	62	73	60	83	62	83	62	77.8	57.1
Hemlock Lake	82	61	78	64	74	61	70	62	74	61	70	59	79	59	72	62	79	58	83	65	85	66	79	68	80	65	82	64	85	66	79.0	62.6
Humphrey	78	56	70	56	78	58	71	63	69	56	71	55	76	48	74	54	78	53	82	57	84	60	81	60	75	58	79	61	80	60	76.9	56.6
Jamestown	85	56	80	62	80	63	77	66	71	60	76	58	81	49	78	57	83	56	86	60	89	64	84	64	78	66	84	64	86	60	80 9	59.0
Lockport	84	60	79	63	68	62	66	60	73	61	75	59	80	60	77	61	76	57	84	62	85	67	79	64	79	64	81	58	84	64	78.6	61.2
Shortsville	85	57	79	63	69	59	65	60	75	60	70	58	76	57	74	56	76	53	81	62	62	66	78	66	79	63	82	64	85	63	78.6	60.7
South Canisteo	85	49	80	56	76	57	77	62	77	60	70	49	82	45	77	54	78	48	83	56	87	60	84	60	77	61	84	60	82	60	80.9	54.9
Wedgewood	83	57	73	61	72	59	70	60	78	61	66	56	81	55	74	55	75	53	79	60	85	65	81	66	76	61	79	64	82	65	78.0	59.2
Eastern Plateau:																																
Binghamton	86	50	73	62	75	59	77	66	77	62	69	59	82	52	71	59	74	56	72	62	83	64	83	66	77	65	80	64	85	65	78.6	59.8
Bouckville	78	48	77	58	67	56	67	62	79	60	69	58	78	52	72	57	74	53	71	56	78	60	78	62	77	61	80	60	81	65	76.5	57.4
Cooperstown	75	47	72	58	61	57	70	58	70	60	69	58	75	53	70	59	68	58	75	58	76	62	76	63	73	65	76	63	81	66	73.9	58.4
Cortland	79	48	84	56	71	58	74	61	78	59	73	60	80	50	82	59	75	54	75	60	80	64	78	64	78	63	81	64	82	65	79.8	57.8
Griffins Corners	75	39	75	61	69	55	77	58	75	57	71	51	78	51	71	52	63	48	71	52	72	58	79	58	75	60	74	62	80	60	74.6	53 7
Meredith	74	43	74	57	64	55	76	60	76	61	68	52	72	50	73	53	67	52	70	55	70	57	74	60	73	61	75	60	80	63	73.2	55.6
Middletown	79	54	81	68	70	61	81	65	78	63	76	61	78	59	77	61	66	59	68	60	72	61	85	67	82	67	79	66	78	68	78.7	63.0
Mohonk Lake	75	51	78	66	70	63	77	57	68	59	70	63	74	62	72	57	61	57	64	57	69	58	80	65	76	65	75	65	75	66	74.3	61.1
New Lisbon	78	41	72	53	66	55	73	59	77	58	68	55	79	48	72	55	69	52	70	54	75	60	78	59	76	61	79	58	82	60	75.7	53.8
Oneonta	78	48	73	59	67	58	77	63	81	60	72	58	81	52	72	57	71	56	74	58	75	63	81	63	79	64	81	62	84	64	78.5	58.0
Oxford	80	47	79	55	69	58	77	65	77	63	71	59	76	51	72	57	74	55	71	60	77	63	80	62	77	63	80	61	83	63	76.9	57.7
Perry City (near)	84	48	78	58	73	58	70	60	78	59	69	58	82	48	76	58	77	49	82	56	88	63	83	63	80	59	82	63	84	63	80.0	57.6
Port Jervis	80	48	82	64	72	62	82	67	83	65	78	60	81	56	79	59	65	60	67	60	75	62	86	67	83	67	79	65	82	68	80.3	60.9
Richmondville	78	42	78	63	67	54	68	58	76	57	74	55	83	52	75	57	68	52	78	56	80	60	80	65	80	62	79	60	82	63	77.3	57.3
South Kortright	76	40	75	56	66	56	80	60	76	60	72	53	77	49	74	54	67	53	74	54	74	60	79	61	78	60	76	60	82	59	76.1	54.7
Straits Corners	85	47	78	63	72	60	78	64	78	63	66	58	80	48	75	57	75	52	76	60	84	62	80	62	78	65	81	65	83	63	79.7	57.8
Walton	81	43	79	53	68	58	78	64	78	60	72	55	79	48	73	53	71	52	66	59	78	61	80	62	79	62	79	61	81	63	77.4	55.6

MAXIMUM AND MINIMUM TEMPERATURES FOR NEW YORK, JULY, 1902 — (*Continued*).

STATIONS.	17.		18		19.		20.		21.		22.		23.		24.		25.		26.		27.		28.		29.		30.		31.		MONTHLY MEAN.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
East. Plateau — (Con):																																
Waverly	90	50	85	61	75	61	80	66	80	63	73	59	87	47	89	58	84	52	85	61	89	61	87	66	81	65	86	64	90	63	84.8	58.7
West Berne	79	42	78	62	67	55	66	58	72	56	74	54	79	52	76	55	78	53	75	55	76	56	82	59	78	67	81	59	83	61	77.9	55.1
Windham	76	40	76	62	68	56	82	59	78	57	76	54	79	54	78	60	77	56	75	53	78	59	82	60	76	61	82	62	80	68	78.3	55.7
Northern Plateau:																																
Adirondack Lodge	66	40	64	45	65	43	59	54	56	48	50	46	61	50	70	48	78	52	69	50	68	52	72	62	73	53	77	52	76	50	69.6	50.4
Axton	70	53	73	52	66	46	62	55	75	56	67	58	77	41	74	46	71	53	74	55	75	56	80	62	81	45	86	46	85	60	75.2	50.9
Gabriels	68	42	69	42	69	48	62	50	72	52	64	52	77	42	74	50	75	53	75	52	75	54	78	63	80	53	83	52	85	62	73.8	52.2
Gloversville	68	46	79	60	68	59	64	59	70	58	66	55	78	52	72	59	71	56	76	59	74	60	82	62	78	61	82	60	83	64	76.8	57.7
Indian Lake	73	37	73	59	66	51	59	54	74	55	69	56	77	40	72	48	68	55	75	57	72	57	80	61	80	46	81	49	85	59	74.5	51.6
Keene Valley	76	40	75	55	67	50	62	57	76	58	66	55	80	56	77	53	77	59	74	60	76	57	84	60	80	52	84	51	85	61	77.0	54.3
Lowville	75	49	74	60	68	57	66	58	72	60	70	54	80	49	74	60	77	58	80	56	79	61	80	66	81	57	87	58	86	64	76.8	57.8
Number Four	70	43	70	56	65	55	63	57	71	62	65	53	75	45	75	56	70	55	75	56	75	57	76	64	77	55	80	59	80	62	72.5	54.7
Saranac Lake	69	42	69	56	68	48	63	55	75	55	68	53	80	46	75	50	75	55	77	56	76	60	81	64	81	58	84	53	85	62	75.0	54.8
South Schroon	64	41	74	52	68	53	60	51	67	55	65	54	75	58	74	51	71	58	71	58	67	59	82	61	78	54	80	55	81	62	73.8	54.8
Wells	67	39	76	53	63	55	64	58	70	57	67	53	83	49	77	51	73	58	73	59	72	57	85	61	85	52	85	53	85	61	77.3	52.9
West Chazy	68	49	73	57	73	56	69	59	73	58	67	56	72	56	78	56	76	65	75	57	76	58	84	63	80	59	84	58	84	65	76.3	58.2
Atlantic Coast:																																
Bedford	75	46	83	69	73	64	84	61	74	61	80	63	79	64	75	61	68	60	69	57	69	61	87	68	83	65	80	66	83	66	79.7	61.3
Cutchogue	73	51	80	68	71	63	74	63	75	61	78	62	76	61	68	61	70	59	71	55	79	64	86	65	87	69	85	68	84	62	78.3	61.4
New York City	84	62	86	74	77	68	85	66	80	66	82	67	81	65	77	68	70	65	71	63	74	66	78	66	84	71	78	71	82	72	80.9	66.3
Primrose	82	48	87	58	80	64	88	65	79	63	84	62	81	59	80	58	70	60	72	50	75	62	90	67	89	65	83	67	85	69	83.6	60.4
Setauket	75	52	82	68	77	64	72	64	75	62	76	65	76	63	75	63	70	61	71	60	73	59	85	67	81	67	80	68	79	64	77.8	62.5
Southampton	72	55	83	68	75	64	72	64	74	61	78	63	75	63	73	61	71	62	71	59	71	54	78	67	80	68	82	69	80	60	76.1	61.6
Hudson Valley:																																
Albany	74	53	77	63	65	58	68	62	72	62	74	62	81	58	75	61	72	61	77	62	71	64	84	68	81	67	83	66	84	67	79.0	61.8
Carmel	69	48	80	62	72	59	78	58	73	57	82	60	80	57	77	60	68	56	75	57	71	60	90	66	82	63	81	65	87	64	79.6	64.0
Honeymead Brook	72	47	82	61	79	60	82	60	73	60	78	57	74	58	75	56	69	60	74	60	72	61	83	60	84	65	80	65	82	62	78.1	59.1
Wappingers Falls	75	52	84	66	73	61	68	62	74	62	78	60	78	58	79	59	68	62	75	58	74	62	86	64	75	62	81	65	83	68	78.3	60.7
Mohawk Valley:																																
Canajoharie	73	46	75	57	69	58	63	59	72	59	72	57	79	53	75	59	70	55	75	56	76	59	80	62	79	62	80	60	84	65	76.7	57.8
Little Falls 1	74	50	74	61	65	57	63	59	67	58	72	60	81	51	75	58	68	57	74	58	75	62	80	63	80	62	80	63	85	67	75.3	58.8
Rome	72	51	77	57	75	86	69	60	78	60	73	60	81	51	80	61	76	56	78	59	79	63	81	63	82	60	84	63	85	69	79.5	59.0

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DAILY PRECIPITATION FOR NEW YORK, JULY, 1902.

STATIONS.	DAY OF MONTH.															
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
Eastern Plateau:																
Addison	.....	.....	.59	.....	.84	1.45	.....	.13	.01	.66	.....	.....	.....	.....	.08	.....
Akron	T.	.....	.46	.....	1.82	.68	.....	.07	.08	.04	.....	.....	.....	.....	.18	.....
Alden	.07	.....	.53	.....	.80	1.30	.....	.....	.23	.01	.....	.....	.....	.....	.....	.....
Angelica	.....	.....	.63	.....	.66	.450	.35	.....	.31	.44	0.1	.....	.....	.....	.....	.....
Atlanta	.09	.....	.52	.....	.77	1.58	.....	.11	.85	.28	.....	.....	.....	.....	.....	.....
Avon	.10	.....	.30	.....	.43	2.01	T.	.....	.11	.10	.....	.....	.....	.....	.02	.....
Bolivar	.02	.....	1.84	.....	.66	1.66	.32	.75	.14	.79	.....	.....	.....	.....	T.	.....
Elba	.03	.....	.26	.....	1.84	4.10	.08	.....	.20	.07	.....	.....	.....	.....	.12	.....
Elmira	.03	.....	.56	.....	1.84	2.60	.....	.03	.....	.83	.....	.....	.....	.....	.08	.....
Franklinville	.....	T.	.73	.....	.73	.92	.93	.13	.34	.37	T.	.....	.....	.....	T.	T.
Hemlock Lake	.....	.....	.42	.....	1.39	2.44	.56	.....	.04	.....	.....	.....	.....	.....	T.	.....
Humphrey	T.	T.	1.84	.25	.50	.35	.15	.25	1.10	.03	.....	.....	.....	.....	.01	.....
Jamestown	.....	.....	1.78	.....	.09	.12	.16	.26	.56	.52	.....	.....	.....	.....	.....	.....
Lockport	.08	.....	.25	.....	.66	.56	.14	.01	.83	.....	.....	.....	.....	.....	.03	.....
Shortsville	.09	.....	.29	.....	.82	.65	T.	T.	.14	.16	.....	.....	.....	.....	.11	.....
South Canisteo	.10	.....	.60	T.	1.80	T.	.20	.....	.52	.53	.....	.....	.....	.....	T.	.....
Wedgewood	.05	.....	.61	.....	1.57	.97	.....	.12	.05	.29	.....	.....	.....	.....	T.	.05
Binghamton Plateau:																
Binghamton	.02	.....	.44	.....	.09	.26	.....	.....	T.	.47	.....	.....	.....	.....	.30	T.
Bouckville	.25	.....	.70	.....	.58	.15	.04	.37	.21	.46	.....	.....	.....	.....	.25	.02
Browns Station	.....	.....	.83	.....	.12	.....	.41	.....	.....	.13	.....	.....	.....	.....	.43	.....
Cooperstown	.15	.....	.38	.....	.82	1.15	.13	.14	.35	.40	.....	.....	.....	.....	.07	.....
Cortland	.30	.....	.38	.....	.33	.....	.62	.25	1.55	.....	.....	.....	.....	.....	.06	.....
Griffins Corners	.09	.....	.38	.....	1.03	.12	.31	.....	.....	.27	.....	.....	.....	.....	.29	.02
Meredith	.12	.....	.38	.....	1.32	.10	.02	.06	.....	.49	.....	.....	.....	.....	.09	.03
Middletown	.07	.....	.59	.....	T.	T.	.....	.02	T.	.....	.....	.....	.....	.....	.03	.....
Mohonk Lake	.18	.....	.62	.....	.30	.12	.15	.....	.....	.08	.....	.....	.....	.....	.97	.....
New Lisbon	.08	.....	.20	.....	.47	.13	.07	.29	.12	.45	.....	.....	.....	.....	.08	.02
Oneonta	.....	.....	.14	.....	1.28	.06	T.	.....	.....	.44	.....	.....	.....	.....	.16	.....
Oxford	.....	.....	.38	.....	.45	.23	.31	.31	.01	.72	.....	.....	.....	.....	.08	.....
Perry City (near)	.07	.....	.45	.....	.35	1.04	.....	.03	.70	.24	.....	.....	.....	.26	.....	.....
Port Jervis	.16	.....	.59	.....	.04	.06	.10	.....	.07	.....	.....	.....	.....	.....	.05	.....
Richmondville	.03	.....	.25	.....	.83	.54	.14	.05	.....	.46	.....	.....	.....	.....	.15	.....
Salisbury Mills	.16	.....	.60	.....	.....	.05	.02	.....	.....	.....	.....	.....	.....	.....	.....	.....
South Kortright	.06	.....	.40	.....	.67	.10	.09	.02	.....	.46	.....	.....	.....	.....	.15	.13
Straits Corners	T.	.....	.48	.....	.50	.25	.10	.10	T.	.....	.....	.....	.....	.....	.20	.09

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Walton	.14		.68		.66	.08	.43			.41					.44			
Warwick	.31		.16				.22			.09					.05			
Waverly	.03		1.39		.98	.66	.30	.01		.78					T.			
West Berne	T.		.26		.48	.13	.16			.23					.37			
Windham		.04		.22		.54	.57	.06			.28				.06		.13	
Northern Plateau:																		
Adirondack Lodge	.60			.21	.35	.31	.65		.45	.35				.11	1.20		.55	
Axton	.42		.64				.36		.34					*	1.02			
Gabriels	.31		.54		T.	.01	.03		.04	.15					.58		.07	
Gansevoort	.40		1.20		.40					.50				.35	.23			
Gloversville	.35		1.40		.34		.04	T.	.78	.87					.32			
Harkness	.56		.32		.02	.11	.43		T.	.27				T.	.56		.06	
Indian Lake	.60		1.37		T.		.07		T.	.35				2.10	.74			
Keene Valley	.59		.27		.03		.05		.07	.33				.15	.95		.09	
Little Falls 2	.50		1.69		.60	.22				.82					.94			
Lowville	.53		1.46		.16		.08	.05	.06	.11				.08	2.70			
Number Four	.49		1.60		.10		.13			.31				T.	1.59			
Saranac Lake	.30		.63		T.		.03	.03	T.	.37					.68		.13	
South Schroon	.54		1.56		.05	T.	.18	.01	T.	.28				.25	.45			
Wells	.43		1.40		T.	.03	.16		.07	.27				.02	.70			
Atlantic Coast:																		
Bedford	.23		.49		.08	.05	.03		.01	.06					.01			
Cutchogue	.28		.27		.34	.66		.03		.03							.04	
New York City	.18		.08		.17		T.			.01					.27		T.	
Primrose	.35		T.		T.	T.	T.	T.		.12					.10			
Setauket	.18		.12		1.28	.13		.03							T.			
Southampton	.21		.20		.77	.96	T.	.03	T.	.02					T.		.39	
Hudson Valley:																		
Albany	.04		.13		.70	.01		.01		.13				T.	.44		T.	
Athens	.05		.26		.68	.18	T.	.01		.21					T.		T.	
Carmel	.20		.65		.03	.10		T.		.06					.16			
Easton	.39	.04	1.04		.26					1.61				.15			.89	
Greenwich	.40		.95		.16	T.		T.	T.	.97					1.20			
Honeymead Brook	.05		.86		.72	.21		.05		.14					.36			
Old Chatham			.32		1.04	.06	T.			.50				.27			T.	
Red Hook	.14		.50			.60			.23						.67			
Spier Falls	.27		1.20		.12					.41					.67			
Wappingers Falls			.78		.30	.16	.04	T.		.07		.12			.32		.10	
Mohawk Valley.																		
Canajoharie	.23		.45	.02	.75	.21	.13	.14	.01	.55				.09	.10			
Little Falls 1	.42		1.12		1.38	.26	.02		.23	.45				T.	.63			
Rome			1.54	1.20	.50		.20								1.22			

T.—Trace, when precipitation is less than 0.01 inch. *Amount included in next measurement.

DAILY PRECIPITATION FOR NEW YORK, JULY, 1902—(*Continued*).

STATIONS.	DAY OF MONTH.															
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
Champlain Valley:																
Caldwell	.50	.....	1.30	.....	T.	T.	.06	.....	.08	.17	.....	.....	.....	.....	1.66	.02
Glens Falls	.40	.....	1.35	.....	.19	.....	.....	.....	.....	.70	.....	.....	.....	.....	1.11	.....
Plattsburg	.80	.....	.30	.....	.41	.....	.....	.....	.....	.20	.....	.....	.....	.15	.70	.16
Saratoga Springs	.40	.....	1.35	.....	.20	.....	T.	.....	.....	1.80	.....	.....	.....	.67	T.	.....
Ticonderoga	.80	.....	.91	.....	.06	.....	.02	.05	.....	.33	.01	.....	.....	T.	.57	.01
St. Lawrence Valley:																
Moira	.20	.....	.22	.14	T.	.....	.05	.....	.10	.....	.....	.....	.....	.....	1.45	.19
North Hammond	.50	.....	.48	.....	.03	.03	.10	.....	T.	.....	.03	.....	.....	.....	.46	.....
Ogdensburg	.05	.....	.15	.....	.03	.....	.14	.07	.08	.....	.....	.....	.....	.07	.37	.03
Watertown	.17	.....	.98	.....	.27	.09	.26	.19	.....	.33	.....	.....	.....	.....	.30	.....
Great Lakes:																
Appleton	.05	.....	.22	.....	2.92	1.68	.....	.01	.36	.....	.....	.....	.....	.....	.03	.....
Baldwinsville	.....	.53	.06	.70	.20	.06	.42	.....	.08	.....	.....	.....	.....	T.	.34	.....
Brockport	.12	.....	.20	.....	.70	1.12	.....	.01	.14	.....	.....	.....	.....	.....	.01	.....
Buffalo	.02	.....	.88	.01	.02	.28	.....	.06	.20	.03	.....	.....	.....	.....	.02	.....
Lyons	.....	.....	.50	.....	.38	1.65	.05	1.12	.06	.....	.....	.....	.....	.....	.25	.....
Oswego	.20	T.	.83	.01	1.64	.21	.33	.06	.02	.25	.....	.....	.....	.52	.04	.....
Palermo	.....	.....	.42	.15	1.07	.26	.....	.45	.....	.....	.....	.....	.....	.40	.08	.02
Ridgeway	.08	.....	.26	.....	2.13	1.47	.....	.03	.28	.02	.....	.....	.....	.....	.05	.....
Rochester	.09	T.	.24	.....	.84	.59	.18	T.	.10	.03	.....	.....	.....	.....	.07	.....
Volusia	.25	.....	1.79	.01	.22	.01	.....	.12	.34	.41	.....	.....	.....	.....	.....	.....
Westfield 2	.09	.....	1.73	.....	.20	.03	.....	.10	.32	.32	.....	.....	.....	.....	.09	.....
Westfield 3	.06	.....	1.52	T.	.05	.....	.....	.....	.28	.18	.....	.....	.....	.....	T.	T.
Wolcott	.17	.....	.60	.....	.63	.31	.06	1.57	.04	.....	.....	.....	.....	.....	.38	.....
Central Lakes:																
Auburn	.....	.....	.65	.....	.98	.....	.01	.18	1.16	.14	.....	.....	.....	.....	.12	.....
Fayetteville	.17	.....	.51	.....	.76	.15	.37	.27	.03	.66	.....	.....	.....	.....	.48	.....
Ithaca	.03	.....	.37	T.	.41	.63	.....	.01	.54	.17	.....	.....	.....	T.	.01	.....
King Ferry	.10	.....	.31	.21	.05	.86	.07	.....	.06	.91	.....	.....	.....	.....	.05	.....
Penn Yan	T.	.....	.27	.....	1.50	.97	.....	.08	.43	.47	.....	.....	.....	.....	T.	.....
Romulus	.04	.....	.04	.....	.16	.88	.41	.17	.85	.70	.....	.....	.....	.....	.....	.....
Skaneateles	.20	.....	.68	.04	.45	.33	07	.32	.52	.20	.....	.....	.....	.....	.15	.....

T.—Trace, when precipitation is less than 1.01 inch. *Amount included in next measurement.

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DAILY PRECIPITATION FOR NEW YORK, JULY, 1902—(*Continued*).

STATIONS.	DAY OF MONTH.															Total.
	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	
Western Plateau:																
Addison	.40	.20	.30	1.04	.....	.....	T.	.53	.23	.05	.....	.32	.02	T.	.....	6.85
Akron	.22	.01	1.28	1.41	.04	.....	.....	.27	.....	.....	.....	.26	T.	.....	.....	6.82
Alden	.15	.03	1.35	1.01	.01	.95	.....	.15	.....	.....	.33	.08	.....	.....	.....	7.03
Angelica	.28	.22	.60	1.40	.03	.57	.23	.82	.....	.18	.09	.24	.44	.44	.02	12.46
Atlanta	.30	.10	1.53	1.82	.05	.32	.....	1.33	.....	.....	.....	.30	.15	.11	.....	10.21
Avon	.17	.21	.88	1.07	.11	.38	T.	.18	T.	.....	.04	08	.....	.....	.47	6.66
Bolivar	.76	.08	.42	.82	.02	.06	.48	1.13	.28	T.	.29	.34	T.	T.	T.	10.87
Elba	.16	T.	1.17	1.03	.07	T.	.....	.25	.12	.....	.08	.18	.....	.....	.....	9.76
Elmira	.38	.05	.42	.62	.13	.....	.....	.05	.19	.....	.....	.01	.02	.....	.....	7.84
Franklinville	.46	.15	.68	1.50	.07	.30	.06	.52	.02	1 15	.02	.34	.67	T.	.....	10.09
Hemlock Lake	.18	.11	1.95	.82	.34	.07	.....	.18	.....	.....	T.	.20	.03	.....	.....	8.73
Humphrey	.65	.65	.67	1.08	.13	.04	.53	.55	.13	.38	.08	.16	.15	.....	.....	9.68
Jamestown	.98	25	.78	1.66	25	.13	.12	1.00	.02	.....	.....	.34	.10	.....	.....	9.12
Lockport	.18	.03	1 06	.80	.24	.....	.....	T.	.....	.....	.....	.86	.....	.....	.....	5.73
Shortsville	.06	T.	.90	1.10	.44	.07	.02	1.04	.12	.....	.09	.08	.02	.....	.....	6.20
South Canisteo	.42	.57	1.22	.62	T.	T.	.25	.30	.....	.90	.....	.10	.05	.22	.....	8.40
Wedgewood	.19	.11	1.81	1.08	.03	.18	.12	1.23	.12	.....	.....	.26	.36	.02	.01	9.23
Eastern Plateau:																
Binghamton	.13	T.	1.11	.61	.14	T.	.....	.76	.54	.....	.63	.01	T.	T.	.....	5.51
Bouckville	.....	.26	.73	.73	1.24	.06	.....	.07	.....	.....	.85	.25	.03	.....	.....	7.25
Browns Station	.....	.....	.65	.....	1.99	.....	.....	.75	.....	.....	.21	.....	.23	.....	.11	5.86
Cooperstown	.05	.....	1.62	2.00	.65	.....	.....	.57	.05	.....	.54	.....	.10	.....	.....	9.17
Cortland	.23	.60	1.10	.80	1.75	.80	.....	.46	.17	.....	.60	.....	.07	.....	.05	10.12
Griffins Corners	T.	.04	.68	.99	2.09	.05	.....	.85	.02	.04	.22	.05	.35	.04	.....	7.93
Meredith	.08	.19	.90	2.47	.08	.05	.....	.29	.12	.....	.80	.22	.....	.22	.16	8.19
Middletown	.31	T.	.14	.43	.55	.35	.....	.30	1.11	T.	.....	.....	.14	.18	.78	5.00
Mohonk Lake	.04	.03	.30	1.00	2.03	.12	.....	4.05	.25	.....	.14	.....	.15	.....	.01	9.75
New Lisbon	.....	.....	1.07	3.76	1.08	.02	.....	.65	.....	.....	.94	.09	.04	.42	.....	10.08
Oneonta	.....	.06	.71	2.58	.28	.39	.....	.23	.07	T.	1.03	.28	T.	.....	.....	7.71
Oxford	.08	.92	1.22	2.02	.42	.10	.....	.50	.....	.....	.52	.30	.....	.08	.....	8.65
Perry City (near)	.16	.20	1.12	1.13	T.	.16	T.	.68	.31	.....	.10	.30	.28	1.94	.....	9.46
Port Jervis	.41	.34	.28	.14	.80	.28	T.	.50	.62	T.	.04	.27	.58	04	.07	5.44
Richmondville	.....	.05	1.00	2.00	.55	.....	.....	.55	T.	.....	.20	.10	.....	.....	.05	6.95
Salisbury Mills	.55	.03	.....	.37	.55	.22	.45	25	.50	.....	.....	.....	.67	.11	.56	5.09
South Kortright	.02	.15	.76	2.15	.16	.02	.....	.53	T.	.....	.27	.10	.....	T.	.15	6.39
Straits Corners	.10	.33	.31	1.40	.55	T.	.....	.45	.45	T.	.88	T.	T.	T.	T.	6 19

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DAILY PRECIPITATION FOR NEW YORK, JULY, 1902—(*Continued*).

STATIONS.	DAY OF MONTH.															Total.
	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	
Eastern Plateau—(Continued):																
Walton	17	.31	.....	3.75	.54	.03	.....	.57	.13	.....	.32	.12	T.	.02	.....	8.80
Warwick	.18	.....	.34	.27	1.15	.42	.....	.55	.90	.....	.06	.78	.48	.54	.08	6.58
Waverly	.25	T.	.62	.40	.01	.....	.....	.33	1.43	.....	T.	.06	.02	.01	.01	7.29
West Berne	T.	.....	.95	1.20	.90	.12	.....	1.43	T.	.....	.27	.10	.30	T.	15	7.05
Windham	.....	.27	.67	.93	1.18	1 63	.....	.62	.06	.....	.18	.....	.....	.....	T.	7.44
Northern Plateau:																
Adirondack Lodge	.19	.32	.43	.32	.54	.22	.....	.65	.....	.....	.18	.....	.....	.....	.....	7.63
Axton	T.	.....	*	.37	.19	.....	.02	.23	.....	.....	.51	.....	.....	.....	.50	4.60
Gabriels	.02	.03	.02	.26	.08	.....	.....	.80	.02	.....	.34	.07	.....	.....	T.	3.34
Gansevoort	.25	.....	.50	1.00	.40	.....	.....	.....	.63	.....	.27	.30	.....	.....	.....	6.43
Gloversville	T.	.....	.73	1.18	.23	.23	.60	.03	T.	.....	.20	.08	.....	.....	.....	7.38
Harkness	.....	.17	.01	.57	.12	.36	.....	.09	.05	.....	.14	.09	.....	.....	T.	3.93
Indian Lake	.10	.....	.25	.59	.55	.....	.09	.10	.02	.....	.28	.....	.....	.....	1.10	8.31
Keene Valley	.02	.....	.05	.48	1.44	.17	.22	.01	T.	.....	.13	.....	.....	.....	.22	5.27
Little Falls 2	.....	.....	.54	.94	.74	.10	.....	.20	.....	.....	.62	.48	.05	.....	.....	8.44
Lowville	.11	.....	.57	.51	.....	.13	.....	.....	.....	.....	.48	.....	.....	.....	.34	7.37
Number Four	.11	.....	*	.87	.02	.....	T.	.....	.....	.....	.49	.....	.....	1.65	.....	7.36
Saranac Lake	T.	.01	.05	.25	.04	.06	.01	.13	.18	.....	.22	.....	.....	.....	.10	3.22
South Schroon	.18	.....	.30	.65	.85	.05	T.	.08	.15	.....	.30	.....	.....	.....	.16	6.04
Wells	.15	.....	*	1.42	.70	.08	.01	T.	.08	.....	.48	.01	.....	.....	.03	6.04
Atlantic Coast:																
Bedford	.25	.....	.36	.19	.25	.35	.02	.15	.06	.01	.01	.09	1.04	.04	.....	3.78
Cutchogue	.34	T.	.07	.05	.02	.....	.....	T.	T.	.....	.15	T.	T.	T.	.....	2.28
New York City	.08	T.	.03	.32	.50	.05	.....	.20	.34	.....	.01	.88	T.	T.	.....	3.12
Primrose	.25	T.	.21	T.	.26	.77	.30	.32	.28	T.	T.	2.05	.22	T.	.....	5.23
Setauket	.35	T.	.09	.07	.16	.....	.....	.....	T.	.....	.....	T.	T.	.....	.....	2.41
Southampton	.64	T.	.05	.08	.38	.02	.....	.....	T.	.01	.....	T.	.....	.....	.....	3.76
Hudson Valley:																
Albany	T.	.10	.55	1.68	.92	.02	.46	T.	.....	.16	.02	T.	T.	T.	.....	5.37
Athens	T.	T.	.64	1.65	.27	.53	.08	1.47	.03	.....	.03	.....	.....	.....	T.	6.09
Carmel	.16	.....	.24	.48	.72	.25	.....	.....	.42	.....	.....	.....	1.54	.20	.....	5.21
Easton	.....	.....	.....	2.10	.16	.....	.....	.03	.69	.....	.09	.28	.04	.....	.....	7.77
Greenwich	.31	.....	.30	.99	.31	T.	.....	.14	.60	.....	.26	.08	T.	.....	.....	6.67
Honeymead Brook	.14	.02	.75	.10	2.25	.07	.....	.65	.02	.....	.27	.....	.02	.06	.....	6.74

Old Chatham	T.		T.	1.64	1.36	1.40		2.10			.10		.10			8.89
Red Hook	.15		.80	.93	.57			1.64	.03		.35		.09			6.70
Spier Falls	.23		.21	1.16	.46	.28		T.	.14		.29		T.			5.44
Wappingers Falls	.08	.03	.24	1.48	2.14	.08		.24	.04		.16		.16		.02	6.56
Mohawk Valley:																
Canajoharie	.05	.12	.53	1.13	.20	.37		.29			.21	.05	.10		T.	5.73
Little Falls 1	T.		.40	1.04	1.22	.04		1.10	.19		.40	.16	.01		T.	9.07
Rome				1.20	.16		.40				.40					6.82
Champlain Valley:																
Caldwell	.14	T.	.58	.71	.44	T.		T.	.26	T.	.80	.04		T.	T.	6.76
Glens Falls	.06		.16	.72	.10	.11			.48		.92	.13		T.		6.43
Plattsburg	.10	.15	T.	.15	.34	.52		T.			.32					4.30
Saratoga Springs			T.	1.67	.70		T.	.21			.10	.18				7.28
Ticonderoga	.02		.10	.68	.07	.10		.16	.53	.01	.42	.01				4.86
St. Lawrence Valley:																
Moira	.64				.98			.18				.05			.41	4.61
North Hammond	.02	.04	.02	.05	.02	.11		.13								2.02
Ogdensburg			.01		.28			.19	.04		.06	.01				1.58
Watertown	.05		.34	.26	.04			.15	.02		.03					3.48
Great Lakes:																
Appleton	.22	T.	.84	.63	.61		.59	.02			T.	.08				8.26
Baldwinsville		.16	1.25	.31	.26		.07	.02		.46	.93	T.		.11	.31	6.27
Brockport	.11	T.	1.18	.77	.25	.02		.09			.03	.18				4.93
Buffalo	.09	.03	1.01	.99	.38	.26		.17			.01	.01	.06			4.53
Lyons	.03		.86	.42	.09	.06		.48	.06		.70	.06				6.77
Oswego	T.		1.02	.26	.02	T.		.26	.04		.76					6.48
Palermo	.03	.10		.05	1.00	.10		.75		1.08	.04					6.00
Rid eway	.17	.03	1.23	.68	.28		T.	T.			T.	.29			T.	7.00
Rochester	.07	T.	.95	.48	.13	.06		.28	T.		.22	.09	T.		.01	4.43
Volusia	.20	.15	.55	1.14	.01	1.98		1.10	.16			.27	.23			8.94
Westfield 2	1.10	.20	.47	1.28	.07	.80		1.31	.12		T.	.15	.14			8.52
Westfield 3	1.30	.19	.27	2.83	.05	.28		.94	.03			.29	.08			8.35
Wolcott	T.	T.	.66	.27	.34		.45	.53			1.01	.01		T.	.15	7.18
Central Lakes:																
Auburn	.06	T.	.68	.95	.01	T.	1.03	.68	.04		.65	.10		.04		7.48
Fayetteville			.45	.98	04	.04		.11			1.75	.10	.07	.05		6.99
Ithaca	.13	.03	.88	1.00	.08	.07	.22	.39	.31		.64	.07	.09	.57	.01	6.69
King Ferry	.09	.68	1.11	2.01		.10		.15	.27			.20	.38	.20		7.81
Penn Yan	.13	.21	1.67	1.15	.01	.56	.01	.75		T.		.54	.29			9.04
Romulus	.06	.06	1 92	1.26	.12	.41	T.	.82			.08	.41		T.	.86	9.25
Skaneateles	.02	.07	.63	1.00	T.		.40	.22	T.		.52	.05	T.	.05		5.92

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Exhibit No. 14.

Report of The Sub-Committee on Statistics of The Rochester Flood Committee.

TESTIMONY TAKEN AT MOUNT MORRIS AND GENESEO, JULY 31 AND AUGUST 1, 1902, BY MAYOR RODENBECK AND E. OCUMPAUGH.

MT. MORRIS, N. Y., *July* 31, 1902.

Mr. E. Ocumpaugh, secretary of the sub-committee on flood statistics, stated the purpose of the visit of the committee to Mt. Morris, viz.: To gather information relative to the amount of damage to crops, lands, buildings and other property in the Genesee valley, by the recent floods, etc.

John F. Connor, Esq., of Mt. Morris, called the various farmers and business men who had suffered damages. Mr. Swett, of Mt. Morris, was the first gentleman called. Mr. Byron Swett who lives in the village of Mt. Morris, and owns farm in valley.

Q. Mr. Swett, you reside in Mt. Morris?

A. Yes.

Q. How long?

A. All my life.

Q. What is your business?

A. Farmer.

Q. Where is your farm located?

A. On the south bank of the Genesee.

Q. How much of a farm have you?

A. Two hundred acres.

Q. How much was your farm valued at before the recent flood?

A. Twenty thousand dollars.

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Q. What effect upon the value of your farm did the recent flood have?

A. It destroyed it, one-half.

Q. How?

A. The water cut a channel through the land, destroying the entire crops, and washing away the soil and trees and buildings.

Q. You estimate your damage to the farm aside from the crops at $10,000?

A. Yes; all within the last five years.

Q. What effect did the flood have on your crops?

A. It destroyed 80 acres of corn worth $20 per acre; and it destroyed other crops of hay, and so on.

Q. What shape did it leave your farm in?

A. It cut off 35 acres and divided the farm.

Q. What effect on the crops?

A. Destroyed the crops.

Q. Mr. Swett, your farm has suffered from previous floods most every year?

A. Yes.

Q. How long has this been the case?

A. Ten or twelve years; I have owned it for thirty years; the floods have been more severe lately.

Q. There was a bank between your farm and the river that protected you for a time?

A. Yes.

Q. During the last fifteen years, how frequently has it been overflowed?

A. Sometimes two or three years between floods.

Mr. John L. White of Mt. Morris, who owns a farm of 650 acres, situated in the towns of Groveland and Mt. Morris, was next called by Mr. Connor.

Q. You are a farmer and live in Mt. Morris?

A. Yes.

Q. What part of the town?

A. Near the town line of Mt. Morris and Groveland.

Q. How large a farm have you?

A. Six hundred and fifty acres.

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Q. How much bottom land?

A. All of it.

Q. What effect has the flood had on it?

A. Destroyed all the crops, and our crops were worth $10,000.

Q. What were the nature of the crops.

A. Beans and hay.

Q. How deep was the water on your farm?

A. Nine feet.

Q. That was a maximum depth?

A. Yes.

Q. How long did it remain on your land.

A. Two weeks.

Q. What other damage aside from the crops?

A. Nothing, only the meadows; it killed them.

Q. What damage do you estimate that it did?

A. I could not estimate it.

Q. Did it wash the farm out?

A. Yes.

Q. What do you mean by killing the meadows?

A. I mean water standing on the grass kills the roots of the grass.

Q. Has your farm been subject to previous flood?

A. Yes.

Q. How frequently has it been overflowed?

A. Not in nine years, to do damage like this flood.

Mr. John M. Hastings, attorney at law and farmer, was the next gentleman called by Mr. Connor.

Q. Mr. Hastings, you are an attorney in practice here?

A. Yes.

Q. You are also interested in a farm here?

A. Yes, about 600 acres.

Q. How far from the village?

A. East and southeast of the village and lies on the South side of the road leading to Geneseo.

Q. On each side of Canaseraga?

A. Nearly all on the west side.

Q. What effect did the recent flood have on your farm?

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A. Destroyed nearly all the crops. Hay and wheat has been entirely destroyed.

Q. What do you estimate the damage to your crops?

A. Not less than $8,000.

Q. Any special damage to your farm by washing?

A. Not serious.

Q. Your farm is subject to floods from high water in the river?

A. Yes, nearly every year.

Q. What effect has the flood on meadows?

A. If it stays too long it destroys the meadows.

Q. How does the water come on to your farm?

A. It comes from the Genesee river; when the river rises, instead of spreading over its banks, it runs south, up the Canaseraga and Chisaqua creeks and spreads all over a very large territory; this usually follows a flood in the summer, and stays until the water in the Genesee river goes down; the water of the Genesee runs up these creeks and spreads out all over our lands. If the flood is a serious one the Genesee river holds the water up here for a long time. It is Genesee river water that does the damage to our lands; the damage from these small creeks is none at all. Upon my farm there is very little washing.

Mr. Brown, of the Genesee National Bank, was the next gentleman called by Mr. Connor.

Q. Mr. Brown, you are cashier of the Genesee National Bank?

A. Yes.

Q. How long?

A. Forty years.

Q. You are trustee of the Fitzhugh estate?

A. Yes.

Q. Where is this farm located, and how many acres in this farm?

A. South of here; 2,500 acres.

Q. How much bottom land?

A. Nearly all of it.

Q. Have you made something of an estimate of the crops?

A. Six thousand to eight thousand dollars.

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Q. The crops have been damaged more or less for years?

A. Yes.

Q. What previous damages since you have acted as trustee?

A. About $1,000 per year from year to year.

Q. Do you include in this damage to the tenants or estate?

A. Both.

Q. Some years it runs higher than this of course?

A. Yes.

Q. How does the water get on the Fitzhugh land?

A. The Genesee river backs the water up the creeks; it backs up the water for six miles, then when the Genesee drops down it takes some time for this water to run off, and in this way it damages the crops.

Q. How much of a territory is subject to these conditions?

A. Between 6,000 and 8,000 acres between here (Mt. Morris) and Dansville.

Q. In the case of the recent flood it has damaged all this territory from $1 to $20 per acre?

A. Yes.

Mr. Sickles was the next gentleman called by Mr. Connor.

Q. Mr. Sickles, you are a farmer and reside here?

A. Yes.

Q. You recently lost a number of acres of crops on the island farm?

A. Yes; 77 acres.

Q. What damage did you sustain?

A. Nearly a total loss.

Q. How much?

A. Two thousand dollars; it was all in sweet corn, peas and beets.

Mr. Fred Simonson was the next gentleman called by Mr. Connor.

Q. You are a farmer and reside here?

A. Yes.

Q. You have some land situated below the Erie depot?

A. Yes; 140 acres.

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Q. How much of it was flooded?

A. All of it.

Q. What crops did you have there?

A. Peas and sweet corn, etc.

Q. At what do you estimate your total loss from effects of flood on this land?

A. Two thousand five hundred dollars.

Q. This same land has been frequently flooded heretofore?

A. Yes.

Mr. James Kyle was next called by Mr. Connor.

Q. Mr. Kyle, what is your occupation?

A. Farmer.

Q. You are on the Goodwin farm, on the north side of road leading to Geneseo?

A. Yes.

Q. How much of the farm occupied by you was flooded during the recent flood.

A. All of it, 97 acres.

Q. What crops did you have in?

A. Beans, corn, potatoes, etc.

Q. What damage to your crops?

A. Two thousand five hundred dollars.

Mr. John F. White, farmer and manufacturer of the town of Leicester, was the next gentleman called by Mr. Connor.

Q. You live in the town of Leicester?

A. Yes.

Q. Engaged in the canning business, also engaged in farming?

A. Yes.

Q. How much land do you occupy?

A. One thousand acres.

Q. How much was flooded?

A. Three hundred acres.

Q. What crops did you have in on the flooded territory?

A. Corn and peas.

Q. What damage did you sustain?

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A. Entire loss; the crops were worth $40 per acre; total damage, $12,000. I estimate this from the value of the peas; I usually harvest the peas at an average of one and one-half tons to the acre.

Q. Dil you suffer other damage from the flood by farmers who planted for you?

A. Yes, loss of 600 acres. These 600 acres were damaged to the extent of from $10 to $15 per acre. I furnished the farmer the seed to plant, and I let them have it for less than what I paid for it.

Q. Did the flood practically put your canning factory out of business?

A. Yes.

Q. What is your total output per year?

A. Two hundred and fifty thousand dollars per year.

Q. Could you give us any information regarding other farms in your vicinity which were flooded?

A. The farm of John Keating, of 160 acres; all into crops; all flooded; crops worth $40 per acre; all destroyed; total damage to crops, $2,400. The Ayrault farm of 100 acres; all into crops; all flooded; damage to crops, $2,000. The farm was worth $90 per acre in value, and flood damaged it so that now it is worth about $45 per acre. It will be five years before anything can be produced on that farm again. The Barrett farm of 300 acres; all into crops and all flooded; this farm was into sweet corn and peas, and some other crops; the crops were valued about the same as mine. On the Woodfall farm there was a loss of crops and nearly ten acres of land washed away; this farm is worth $110 per acre.

Q. How often during the past ten or fifteen years has this farm been flooded?

A. Nearly every year.

Mr. Byron Swett recalled.

Q. What effect did this recent flood have on the south bank of the Genesee river, north of the D. L. & W. Railroad?

A. It broke down the banks and washed them away.

Q. What will be the effect in the future?

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A. It will flood all the land around there every year; all the lands adjoining mine; they are all exposed on account of this bank being washed away.

Q. In all how much would be flooded each year on account of this?

A. Two thousand five hundred acres.

Mr. John M. Prophet of the firm of Winters & Prophet, proprietors of canning factory, was the next gentleman called by Mr. Connor.

Q. Mr. Prophet, you reside here and are a member of the firm, Winters & Prophet?

A. Yes, sir.

Q. Canners and farmers.

A. Yes, sir.

Q. How many acres of land do you operate?

A. Three hundred acres in the town of Mt. Morris.

Q. How much of this land was flooded by the recent flood?

A. Two hundred and fifty acres.

Q. What crops did you have on the flooded territory?

A. Peas and corn.

Q. Can you give me an estimate you sustained in damages on the 250 acres?

A. Forty dollars per acre.

Q. That was by reason of loss to crops without reference to prospective loss in the canning business?

A. Yes, sir.

Q. How many acres more did you have grown for you here?

A. One thousand five hundred acres.

Q. How many acres of that ground has been destroyed by this flood?

A. We figure about one-half of it has been destroyed.

Q. And other half somewhat damaged?

A. Yes, sir.

Q. You estimate the loss to your crops on your 250 acres at $40 per acre, or $10,000?

A. Yes, sir.

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Q. And the loss to the farmers on their 1,500 acres?

A. Twenty-five dollars per acre on the 1,500 acres.

Q. How many acres of peas did you have grown for you?

A. Six hundred acres.

Q. What portion of that was damaged or destroyed by the flood?

A. Two hundred and fifty acres.

Q. At what do you estimate your loss from damage to the peas?

A. Seven thousand dollars.

Q. Now give me an estimate of the loss to the farmers on that territory.

A. Forty dollars per acre for the 250 acres.

Q. On these same farms on which the peas and corn were destroyed, there are other crops destroyed?

A. Yes, sir.

Q. You couldn't give me the acreage?

A. No, not very well.

Q. How many years have you been in the canning business?

A. Twenty-five years.

Q. Is it anything unusual to have some of your crops destroyed?

A. No; nearly every year; from overflowing of the river up the banks of the creeks.

A. C. Olp, Esq., was the next gentleman called by Mr. Connor.

Q. You are an attorney here?

A. Yes, sir.

Q. In the farming business also?

A. Yes, sir.

Q. Where is your land located?

A. Southeast of the village.

Q. How much of a farm have you?

A. Fifty-six acres.

Q. How much was flooded?

A. All of it.

Q. What crops did you have on the land?

A. Corn, peas and oats.

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Q. How much damage did you sustain?

A. One thousand two hundred dollars.

Q. Have you in previous years suffered also from floods?

A. Yes, most every spring and sometimes in the summer.

Mr. John F. White recalled.

Q. Do you know the James Shefland farm in Leicester?

A. Yes.

Q. Where is it located?

A. The second farm from the river on the Pine Tavern road.

Q. How much flooded?

A. All of it.

Q. How many acres?

A. Forty acres; all damaged.

Q. Any other farm that you could tell us of?

A. The Jane Shefland farm of 160 acres; all flooded; all into corn and peas.

Q. What would be an average damage per acre?

A. Twenty-five dollars per acre.

Q. Any other farm?

A. Mr. Wall's farm of 195 acres; all flooded; estimated damage, $25 per acre. The Perkins farm of 150 acres, all flooded; same conditions; average damage, $25 per acre. The Worcester farm of 250 acres; 150 acres on the flats; all flooded; total loss of all crops on the 150 acres, at an average loss of $25 per acre. The Cummings farm of 250 acres; all flooded; average damage, $25 per acre. The Jennings farm of 160 acres; average damage, $25 per acre. This farm was one vast lake; none of the land visible; average depth of water from two to ten feet. Jos. C. Cameron farm, 200 acres, total loss, $25 per acre. John Wemple farm, 40 acres, $25 per acre. H. Wemple farm, 18 acres, $25 per acre. Miss Wemple's farm, 70 acres, $25 per acre. Geo. Dailey farm, 27 acres, $25 per acre. Jones Estate, 37 acres, $25 per acre. Stocking farm, 56 acres, one-half loss of all crops, $12.50 per acre. C. W. Merwill farm, 36 acres, 18 acres flooded; one-half loss, about $15 per acre. C. Stevens farm, 86 acres, all flooded, nearly two or three feet under water, nearly all crops

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destroyed; loss, about $2,000. Chester White's farm, 60 acres; damaged, $10 or $12 per acre. Truer farm, 75 acres, all flooded, damaged $30 per acre. And there are other small farms. McLean farm of 240 acres, 150 acres flooded, 100 acres damaged about $25 per acre.

Mr. John M. Prophet recalled.

Q. You operate a canning factory at Geneseo as well as here?

A. Yes.

Q. What acreage do you grow yourself there?

A. Three hundred acres; pease and corn.

Q. What portion of that farm was damaged?

A. Two hundred acres valued at $40 per acre.

Q. What is your damage there to the crops outside of the damage to the canning factory?

A. Five thousand dollars.

Mr. A. C. Olp recalled.

Q. Do the spring floods cause any damage?

A. They do; sometimes they come in February; the ice freezes, and then the water recedes; then the ice drops down on the land, smothering the wheat and seeding, and sometimes kills the old meadows.

Q. And this occurs more or less on the bottom land, year after year?

A. Yes.

Q. That's a direct damage sustained from the spring floods often heretofore?

A. Yes.

Mr. John L. White recalled.

Q. You heard Mr. Olp's statement in reference to spring floods?

A. Yes.

Q. Have you seen that effect on your land?

A. Yes; in the case of wheat, mostly. We had thirty-five acres of wheat killed by the spring flood; the ice dropping down

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on the land after the water had run out; we ploughed it up and put it into beans; they were destroyed by the recent flood.

Q. Is Mr. Olp's statement true of all the territory around here?

A. Yes.

Q. Yours included with all the territory around?

A. Yes.

Mr. Brown recalled.

Q. You have heard the statement of Mr. Olp and the statement of Mr. White in regard to ice in the spring?

A. Yes.

Q. And that occurs every year?

A. Yes.

Mr. A. C. Olp recalled.

Q. Could you estimate the number of acres that to your knowledge have been destroyed by the spring floods, and later replanted and again destroyed by the recent flood?

A. Seven hundred acres.

Mr. Cameron, Dr., was the next gentleman called by Mr. Connor.

Q. You are a farmer here?

A. Yes.

Q. How many acres in the farm you occupy?

A. Four hundred.

Q. What portion of your farm was flooded?

A. Pretty much all of it.

Q. How many acres of crops destroyed?

A. One hundred acres of sweet corn.

Q. What was the value of that per acre?

A. Well, we generall y get four tons to the acre and it is worth $6.00 per ton; then the stalks are worth something for fodder, about $3.00 or $4.00 to the acre.

Q. What other crops did you have destroyed?

A. Thirty-nine acres of peas.

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Q. Total loss?

A. Twenty acres a total loss.

Q. Worth about $40 to the acre.

A. Yes.

Q. What other crops did you have damaged?

A. Twenty-six acres of oats; 20 acres of corn worth $25 per acre, and 50 acres of hay worth about $1,500.

Q. What other damage?

A. Five acres of potatoes.

Q. Total damage?

A. Yes; I would have had at least 500 bushels and they would be worth at least fifty cents per bushel.

Q. How many acres of pasture land did you have damaged?

A. Twenty-five acres; damaged about $3.50 per acre.

Q. How much of it washed out?

A. Not so very much of it.

Q. Any other damage on this farm?

A. There was 40 acres of wheat that belonged to Mr. Jacobs; it was entirely destroyed and it was worth $1,000.

Q. On your estimates you have made no allowance for the value of the straw?

A. No.

Q. And the straw is worth something, is it not?

A. Yes.

Mr. John L. White re-called.

Q. Mr. White, aside from the damage sustained by the farmers on account of the loss of crops, such as peas, corn, oats, etc., is there not another damage sustained by the farmers on account of loss of the fodder left after the main part of these crops have been sold?

A. Yes, sir.

Q. What is the situation here of our farmers with reference to their stock?

A. They have nothing to feed them. They've got to sell them.

Q. Is that true of many farmers in the valley?

A. Yes, sir.

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Q. Is there considerable profit to the farmers from keeping young stock?

A. Yes, sir.

Q. What effect has this flood had on the labor here?

A. It has put them all out of business; every farmer has had to discharge his help.

Q. And these people are fathers and sons, the support of families?

A. Yes.

Mr. John M. Prophet recalled.

Q. How many do you employ on your farms in the fields during the summer?

A. From 300 to 400, women and children.

Q. How many in Geneseo?

A. Two hundred.

Q. In your factory how many do you employ?

A. Two hundred.

Q. Your season begins in June and is completed when?

A. October 1st.

Q. What would be the earnings of the average woman employed per day?

A. Seventy-five cents per day.

Q. And a young girl from 14 to 16 years old?

A. Fifty to sixty cents per day.

Q. And a girl in the factory, how much per day?

A. Seventy-five cents.

Q. What do you pay the men?

A. Twelve and one-half cents per hour.

Q. What effect has the flood had on this labor?

A. It has diminished it about one-half.

Q. About how much is that?

A. It will make a difference of $15,000; at least $15,000 is lost to the homes of poor people of this vicinity, and there is no other employment.

Q. Do the same conditions prevail at Geneseo as here?

A. The same conditions.

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Mr. John F. White recalled.

Q. How many do you employ in your factory?

A. One hundred and fifty.

Q. How many in the fields?

A. Twenty-five.

Q. You heard Mr. Prophet in reference to the loss sustained by the working people employed by him?

A. Yes.

Q. And it is true in reference to you?

A. Yes.

Q. What portion of labor has been lost to the people employed in your factory?

A. A loss of $8,000 or $10,000.

Q. And these people live in Mt. Morris and come from poor families?

A. Yes.

Hon. A. J. Rodenbeck addressed the farmers and business men present, giving an account of the appointment of the Flood Commission, its members, etc.; also told of the object of the Commission and the causes leading up to the appointment of the same.

The committee, accompanied by a number of farmers and business men of Mt. Morris, drove about visiting a number of the farms which were flooded.

The first farm visited was the farm of Mr. Byron Swett; an account of the damages sustained by Mr. Swett has been already given. The water cut a channel through this farm, and washed away a number of acres of fertile soil; also swept away a large number of trees and washed away the foundation of a large barn, causing the same to fall.

The next place visited was the farm of Mr. Michael Long, owned by Major W. A. Wadsworth of Geneseo. The farm consisted of 220 acres, and the crops were damaged to the extent of $2,000 or $3,000; the farm land was damaged to the extent of $1,000.

The Chas. Stevens farm was next visited; this farm's crops were damaged to the extent of $2,000.

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The farm occupied by Mr. Cameron, Jr., owned by Major W. A. Wadsworth, was damaged to the extent of $2,000 to the crops.

On the Jones Bridge road, in the town of Leicester, the water-marks on the fences were five feet from the ground.

The next farm visited was the farm of John L. White; this farm consisted of 650 acres in the towns of Mt. Morris and Groveland, between the D. L. & W., and D. & M. railroads. An account of the damages to this farm has already been given.

GENESEO, N. Y., *August* 1, 1902.

The members of the committee interviewed Major W. A. Wadsworth, Mr. Wm. A. Brodie, Mr. Herbert Handy and Mr. Jas. Robinson.

Major W. A. Wadsworth stated that in March last he lost 38 head of cattle which were in one of his barns on the flats; he also stated that during the past few years he had had 25 acres of fertile land swept away by floods; also had sustained heavy losses by reason of having his fences swept away.

Mrs. Mary Wadsworth Chandler, of Geneseo, owns 600 acres of land in the town of York; this land was all leased to small farmers who had their crops all destroyed.

Jas. W. Wadsworth owns 1,900 acres of land on the flats; this land was all flooded.

The following named are farmers and business men who have sustained losses by reason of the recent flood:

T. L. Hall	Geneseo, N. Y.
Arthur Cummings	Geneseo, N. Y.
Willis Willard	Geneseo, N. Y.
Frank Hagen	Geneseo, N. Y.
Jos. Blair	Geneseo, N. Y.
Jas. Haley	Geneseo, N. Y.
John McKay	Geneseo, N. Y.
John Kelley	Geneseo, N. Y.
Jas. Calihan	Geneseo, N. Y.

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Michael Donahue	Geneseo, N. Y.
Wm. Ewell	Geneseo, N. Y.
Chas. Marsh	Geneseo, N. Y.
Mina Averill	Geneseo, N. Y.
Chas. Werner	Geneseo, N. Y.
H. B. Dodge	Geneseo, N. Y.
Louis Chattman	Geneseo, N. Y.
Geo. Rice	Geneseo, N. Y.
Mofatt & Lang	Geneseo, N. Y.
Neff & Neff	Geneseo, N. Y.
Edw. Henrietta	Geneseo, N. Y.
Fred Nexon	Geneseo, N. Y.
Broffatt & Worcester	Moscow, N. Y.
John C. Brown	Piffard, N. Y.
Teall & Fitzgerald	Geneseo, N. Y.
Holden & Colbin	Geneseo, N. Y.
Wm. Mann	Wadsworth, N. Y.
John Rossburg	Piffard, N. Y.
Jas. Filmore	Piffard, N. Y.
Samuel Finley	Geneseo, N. Y.

Respectfully yours,

WILLIAM C. MEAGHER,

Stenographer.

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Exhibit No. 15.

Copy of Report on Genesee River Storage Surveys.

By GEORGE W. RAFTER,

Engineer in Charge,

To CAMPBELL W. ADAMS, State Engineer and Surveyor.

January 1, 1897.

[This report is not printed here but it may be found in the Annual Report of the N. Y. State Engineer and Surveyor for the year 1896.]

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Exhibit No. 16.

OFFICE OF THE PENNSYLVANIA RAILROAD COMPANY, BUFFALO AND ROCHESTER DIVISIONS, 314 BABCOCK STREET, BUFFALO, N. Y.

August 22, 1902.

Mr. E. A. FISHER, *City Engineer, Rochester, N. Y.:*

Dear Sir.—Replying to your favor of July 16th, in regard to your having water marks placed along the Genesee river and its tributaries, showing the height to which water has raised during high floods, I beg to say that in accordance with your request we have had marks placed at the following points:

Subdivision 2—At Sand Hill curve.
At a point south of toolhouse, Genesee Junction.
At a point 2,000 feet north of White's crossing.
At mile post No. 8.

Subdivision 3—Station at Honeoye Junction.
At sign post at bridge No. 1.

Subdivision 4—Ninety feet south of Avon station.
North of Avon station.
South of White Creek curve.
Two hundred feet south of White Bridge.
Two hundred feet north of White Bridge.

Subdivision 5—Mile post No. 26.

Subdivision 6—Retsof Junction.

Subdivision 7—Bridge No. 5.
1,320 feet north of mile post No. 39.

Subdivision 8—Whistle post north end of Fishers siding.
North end of first culvert north of Fishers.
North of mile post No. 43.
Lock No. 14.
North of mile post No. 42.

Subdivision 9—Bridge No. 16.
Bridge No. 17.
300 feet south of Tuscarora, on telegraph pole.
Pump house, Tuscarora.

Subdivision 10—Mile post No. 53.
High Bridge deep cut.

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Subdivision 11—Tool-house, Portage.
Subdivision 12—Trestle north of Rossburg.
Colegrove curve, Rossburg.
Subdivision 13—One-quarter mile north of mile post 67, on telegraph pole.
One-quarter mile north of Fillmore, on crossing sign.
Tool-house near bridge No. 26.
One-quarter mile south of mile post 69, on whistle post.
One-quarter mile north of mile post 70, on telegraph pole.
Subdivision 14—Bridge No. 28.
Bridge No. 16½.
Mile post No. 71.
Mile post No. 72.
Subdivision 15—300 feet south of mile post 76, on telegraph pole.
1,500 feet south of mile post 76, on telegraph pole.
600 feet south of L. & P. junction, near mile post No. 80, on telegraph pole.
Subdivision 16—Mile post No. 88.
Lime Creek trestle.
North of Lime Creek trestle.
Switch target, Black Creek passing siding.
Black Creek station.
Mile post No. 87.
Subdivision 17—Mile post No. 88.
Mile post No. 89.
North of Cuba road crossing.
Cuba water station.
Subdivision 18—Bridges Nos. 42 and 43.
Chapins road crossing.
Swains branch.
Millers road crossing, south of Nunda Junction, on telegraph pole.

Yours truly,

GEO. P. MILLER,
Assistant Engineer.

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Exhibit No. 17.

REPORT OF THE RIVER COMMITTEE OF THE COMMON COUNCIL, MARCH 20, 1866.

To the Honorable the Common Council of the City of Rochester:

The undersigned, to whom it was referred to ascertain and report the most practical and economical measures to provide a sufficient channel for the Genesee river through the city and prevent damage by floods, respectfully submit the following report:

Your committee at once discovered that the subject was surrounded with grave and perplexing difficulties, and they have therefore necessarily devoted much time and study to its investigation.

The able and elaborate report of the State Commission on the causes of the late inundation renders it unnecessary for the committee to enlarge the limits assigned it.

What may be a sufficient channel depends upon the magnitude of the floods. While great freshets may be unfrequent, there is every reason to believe that as the region drained by the Genesee river becomes cleared of its forests, and the present retarding causes are removed, greater floods than heretofore known will occur. We may reasonably expect that at irregular intervals the elements will conspire as in the last dreadful disaster, and convert the Genesee valley into a lake, which will make its way to the sea regardless of the obstacles that may be built in its course. The last flood was caused by a warm rain upon a considerable body of snow, quickly melting the whole mass, and the average accumulation was equal to a stream 640 feet wide, 12 feet deep, and flowing at the rate of 10 feet per second.

Such a stream would drain the whole watershed one inch in depth in nineteen hours.

The sudden melting of large bodies of snow under the influence of long rains sometimes produces water to the depth of eight inches and upward.

The demand for wood and water during the last few years has stimulated the inhabitants of the country drained by the river

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to clear up forests, mountains and swamps, which before held back their waters until the open fields were bare and drained. And the countless rivulets before clogged by floodwood, brush and leaves, and the improved state of agriculture now everywhere to be seen, in which ample drainage is used, show at a glance that every year will naturally increase the magnitude of the floods by the facility with which the waters may be accumulated. This has been the experience of the countries of Europe.

Rochester lies many hundred feet below the main sources of the river, and a part of its site is a basin drained only by the river channel. The future, like the past, will witness great and sudden floods in the river. It is probable that the late freshet exceeded all others in magnitude since the settlement of the village of Rochester. There were great floods in 1785, 1817, 1818, 1835 and 1841, at intervals of 32, 1, 17 and 6 years respectively. And the conformation of the river banks shows that for ages it has been a river of floods. In the nature of things it must be so. Every river has its characteristics and should be regarded accordingly.

To provide a channel for such vast and sudden accumulations through a city where the river has been cheated of one-half of its natural bed, and dammed up above and below at narrow and critical points, bridged with structures which are themselves serious impediments, and everywhere cramped, deflected from its course and encroached upon, is an undertaking fraught with many embarrassments. If we were required only to say what is the most speedy method of providing such a channel, regardless of private rights or the artificial structures, the task would be comparatively easy; but these structures and encroachments are of great value, and the use of most of the latter largely contribute to the material prosperity of the city.

Although it may not be strictly within its province, the committee cannot forego an expression of surprise and regret at the unprecedented encroachments by the people of the city upon the natural and necessary bed of the river. The evil is seen nearly the whole extent of the stream south of the falls. Whole building lots, nay, whole streets, have been made in the ancient bed of the river, and while some are doubtless more to blame than

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others, the whole population is chargeable to some extent. The present generation is not alone responsible, for these encroachments begun, as they were, at an early period; but their extent and rapidity might well lead us to believe that if not arrested and the floods withhold their fury, the next generation may shake hands across the river from the upper stories of their buildings.

The committee believe that these evils are less the result of Christian forbearance than neglect on the part of the authorities and those immediately interested, and the time has come when the people and the city authorities should resolve that not another foot of the present attenuated channel shall be taken for public or private use. Constant vigilance will be necessary, for, unawed by the terrible judgments of the late disaster, the flood had hardly subsided before new encroachments which had been begun both above and below Main street bridge were prosecuted and have since been completed.

It was the remark of an European, while yet the streets were filled with water, that our people were so recuperative the damages would soon be repaired, and true as strange, they stopped not to mourn or consider, but actually used the water from the streets to clean their buildings from floor to floor as it passed away. New buildings in Front street were immediately erected on the spot where a terriffic torrent had swept away the old ones, and a railroad bridge was thrown across the river and used in ——— days from the destruction of the old one, and upon the same spot, without any insurance against a repetition of the disaster.

We wonder that the dwellers on the slopes of Vesuvius, fleeing from its fiery wrath, should go back and build again upon the ruins of buried homes and buried friends; but they will not outstrip our own people in their daring till they plant around the crater itself or build in the gorges.

They build in the track of the flood; it sweeps away their walks, and they build anew. They hang a bridge on spider webs over the yawning gulf, and travel it; the snowflakes bear it away in a night, and they laugh and keep up the facetious warning upon the banks, "' Five dollars fine for crossing this bridge faster than

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a walk." We are a fast people. Sibley sends the lightning cross-lots around the world, and Clum makes an oracle to tell us of the storm when it is afar off. How fortunate for us if a little such genius and enterprise were enlisted in the interest of the city government; an oracle be built for the city, whose inspiration shall be the public good. As a corporate body, we should be guided in our public works by competent engineers and the dictates of common sense. Both these lights must have been extinct when some of our works were constructed.

We believe that an attempt to restore the river to its original channel or any considerable part of it would be an endless and fruitless task. The interests of the people in the encroachments are great, various and complicated. To remove all the obstructions with or without compensation would be ruinous. It was the water power which determined the first settlers to found a city here, and the privileges on the river and the races radiating from it have given Rochester its chief reputation and importance. This power should be saved and fostered, and manufacturers attracted here to enrich the city with its undeveloped wealth.

With a studious eye to ample and permanent relief at the smallest expense, and a desire to save all private interests as far as compatible with the public good, we have concluded to submit two plans to the Board:

PLAN FIRST.

The first thing to be guarded against is the flooding of the feeder and the Genesee Valley and Erie canals. The Legislature should be petitioned to raise the bank of the feeder on the river side at all points where it is necessary, the whole length thereof.

The unused guard lock now in the canal at the rapids should be removed to a suitable point between its present position and Plymouth avenue, which, with proper surroundings, would be a perfect protection to the city in that direction. It was to prevent the river from flowing through the canal that this lock was built, but it was not located at the proper place and is not used. Three times the river has broken into the canal at the rapids, and we believe the lock a far better protection than the wall recommended by the State Commission.

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In the late flood the water broke into the canal and into the feeder, the result of which is well known; and it would seem eminently just that the State should secure the city against further danger from its own works.

A wall should also be built on the west side of the river, from the Johnson dam to the high ground near the foot of Edinburgh street, to prevent an overflow in that exposed part of the city. If these works should answer the object intended, they would conduct all the waters of a flood to the dam, and should all be done by the State, except the last mentioned wall. This dam was first erected in the year 1817, and at its present height sets the water back to a point south of Clarissa street bridge. It is believed that no form of gate in the dam is practicable, and that it cannot be cut down and the necessary head of water secured by flushboards or any other moveable contrivance. This structure has stood over twenty years undisturbed, and the right to set back the water upon the territory above it (to the extent of the old dam) may have become prescriptive and defensible.

At the late flood, the water at its height was ten feet deep on the crest of the dam. The bulkheads of the two races there had been carried away, each of which is about sixty feet wide, and cut down to the rock, which, together, made an opening above the dam 120 feet wide, and ten feet deep above the crest. These races were a greater relief to the dam than the cutting down of two feet would be, as a calculation will show. The races carried off 1,200 square feet in a given time, while by the same velocity the two feet of depression would carry off but 800 feet in the same time.

The bulkheads have been built anew, and sufficiently strong, it is supposed, to withstand a similar flood, so that an outlet to the same extent may not be expected there again. By an arrangement with the parties interested, the removal of the gates to points near the aqueduct might be effected, which would practically lengthen the dam. The water pouring over the walls into the river, no waste gates would be necessary. This is recommended by the committee.

It is the opinion of all the engineers and other competent persons examined by us, that the works aforesaid on either side of

the river would render this dam comparatively harmless if ample means are provided below it to carry off the water, and so we believe.

The next obstacle is the new aqueduct. The water, if unobstructed by the aqueduct, would have an average velocity of about eight to ten feet a second in ordinary freshets.

The aqueduct has seven waterways, each of fifty-two feet span and fourteen feet in height to the crown of the arches, and a capacity of 4,020 square feet. They are built obliquely to the thread of the stream, and are insufficient in capacity to the requirements of such a flood as that of last spring. But if another archway of the same dimensions was built at the west end, and all of them were quarried out eight feet deep, and the whole bed of the river excavated a proper distance above and below, and proper starlings built on the south side of the piers, ice-breakers placed above it to give direction to ice and floodwood, it would admit the waters of any flood we may ever expect to occur. This is also properly the work of the State, and we are assured it would be cheerfully done if required as a part of the necessary measure.

The river bed between the dam and the aqueduct should from year to year be quarried as stone may be required, and also the bed on the west side, between the aqueduct and Main street bridge, where the rock a part of the way is now much higher than on the east side and tends to direct the stream in that direction. It would also increase the velocity.

Main street bridge is the next great obstacle. It seems to have been built with reference, not to the demands of the river, but to the present capacity of the aqueduct. It is a monument of errors. There are five waterings, three of 42 feet span, and an average of 21 feet from the bed to the crown of arches, and two of 30 feet span and an average of 18 feet to the crown of the arches. The piers and the whole south face present a flat surface to the stream, and therefore in their present state no amount of pressure can ever fill the arches to their full capacity. The crowns of the arches are too thick and much room is thereby lost. They should have come near the surface of the roadway.

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It is unnecessary to specify the defects, for all know the waterway is inadequate. At the late flood the water was 28 feet deep on the south side, and although the velocity of the stream through the waterings with such a head is estimated at twenty-four feet a second, the river burst over the west end and carried destruction through Front street to the railroad depot. When it is considered that more water was diverted by the canals and in various other ways than could have passed through another arch of the largest size at the bridge, we may imagine what would have been the result if the whole body of the stream had been kept in the channel. It is more than probable that in such a case the western half of the bridge itself would have been carried away, and all Front street with it.

It is too true that the eastern arch was greatly obstructed and that debris in large quantities lay in the channel, but these obstacles were not sufficient to account for the overflow. The Messrs. Newell have since removed the obstruction. Actual measurements of the volume of water and the waterings of the bridge demonstrate that with arches clear and any given head they would not have been sufficient.

This point is too vital to rest in doubt; room must be had for the greatest floods or our citizens will build on the sand. The plan of the Engineer to the State Commission to raise the south face and extend a wall on the west side to Mr. Van Zandt's mill, and thereby dam the river, and by force of a great head drive the waters of the floods through these passages, we believe is visionary and hazardous. The best argument against it is a view of the structure and our sad experience. The whole space from the roadway to the bed of the river is nearly half filled with masonry. The area of watering is twenty feet narrower than the narrowest place at any point below the bridge. An ordinary freshet reaches the spring of the arches, and above that there are but the segments of five small circles. It is doubtful if any amount of patchwork will ever remedy the defects. To uncap the bridge and build the arches as high as the roadway would be a great expense, and insufficient.

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There is not room for so many piers, to say nothing of the space between the arches. We believe that enough cannot be safely quarried under the archways as they now are to make them adequate, even if the lower dam was wholly removed, and with the dam standing, to deepen the channel below the bridge would do no good. Nor do we think the plan of said Commission to cut a channel from the falls to the bridge and through the central waterings, advisable, because the space thus gained through the structure would be inadequate. No relief below the bridge, not even a precipice, would compensate for the smallness of the arches. It would be like an inverted funnel, whose measure is the capacity of the small end. Suppose a head of thirty feet on the south side and a precipice at the north side, would the arches have carried the whole flood of last spring? We think not. One or two archways of seventy feet span in the aggregate at the west end, with all the beds quarried out five feet. Starlings to all the piers and ice-breakers above, would have discharged the flood of last year, but not the amount of the aqueduct when enlarged and improved as contemplated. These improvements would be a safeguard at this point against such floods as have yet occurred, but to make the bridge ample the roadway and arches should be removed, as large a watering as possible made at the west end, half of the old piers taken up and all remaining built up, and an iron bridge substituted like that at Court street, or of some other model. But if a trial should show it best to leave all the piers, it may be safely done.

In considering the bridge the surroundings should be observed. The lower dam, which is four feet high and constructed like the upper one, sets the water back to a point above the bridge, and while it remains at its present height no amount of excavation either at the bridge or all the way to the dam will avail, except that by a sufficient head above the bridge the water may be forced through the arches, and by elevation alone overcome the resistance below. Such a head cannot be had with piers and an iron bridge, nor can it be had in any case until the bridge becomes a dam, which should never be allowed. If floods are to be pent up at

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the bridge at uncertain heights and relieved only by increased velocity through the waterings, all depending upon the height, we shall never feel secure. The capacity of the bridge would be limited to an exact quantity, while the quantity to be provided for is uncertain. As the width is limited at best, the height should be great. The cheap iron bridges all withstood the late flood without material injury, thus showing that these waterways are of greater capacity.

Nothing can be gained by a general deepening of the river bed below the bridge, so long as the lower dam remains, because it would only make a pond as deep as the dam.

The removal of the lower dam or cutting it down would relieve the almost perfect level between the bridge and the dam, but its removal would ruin Brown's race. Cutting it down would require a corresponding deepening of the race and a readjustment of all the propelling machinery located on the same. Gates are impracticable.

This dam was erected over twenty years ago and has remained undisturbed. At the late flood it was discovered that the wall built on the west side below the railroad bridge retards the stream and sets the water back on the dam. It could not do otherwise. Its direction is oblique to the thread of the stream, and at present is a serious impediment. The piers of the railroad bridge are imbedded in the rock, and we are assured that the company, if permitted, will quarry out the river bed from the dam to the falls. That might render the removal of the wall unnecessary; otherwise it should be changed.

Where the new passage at the west side of the bridge should enter the river is a question not necessary to determine now, but we think not lower than the McIntosh block.

The bed of the river, in many places, from the lower dam to the aqueduct, is obstructed by debris of various kinds. The eastern arch of the Main street bridge is practically contracted by the projection of Mr. Erickson's building. Subcellars to the stores on the north side of the bridge project below the crowns of the arches. A section of the old aqueduct remains, and a wing

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wall between the two aqueducts extends into the river. All these should be removed, whatever measure is adopted. Starlings to all the piers should be built and ice-breakers made above. The starlings help to fill the waterways and permit greater velocity.

PLAN SECOND.

The second plan is a tunnel extending from a convenient point above the foot of the falls, on the west side under Front street, or the river to a point between Main street bridge and the aqueduct; or, if the State will continue it, to a point above the aqueduct. Then the water, when above the surroundings of its mouth, would descend and with great velocity disappear from the stream. The necessary size is estimated at ten yards square, or an archway equal to that in area. This plan is not the invention of the committee, but if adopted would be a full and complete solution of all the difficulties below the upper dam.

If the above dimension should prove insufficient, it might be enlarged according to the demand. The mere statement of this plan is sufficient, as all who have bestowed any thought on the subject of the river will concede. The work could be done without interruption by water or seasons, and at lower wages to laborers. We think it would cost much more than the first plan. The bridges must remain and be kept in repair, with or without a tunnel.

In this report we have purposely omitted the elaborate data and calculations on which our opinions are founded, and refer to the report of Daniel Marsh, Esq., Engineer, who, with the City Engineer, has largely aided us. We submit the report with confidence in its correctness in the main, as our views are sustained, we believe, by nearly all the engineers who have generously given the city their opinions.

The importance of this subject can hardly be overrated. The late flood cost the city and its inhabitants more than all the expense required by either of the above plans, and no one can tell how soon it may be repeated even in greater quantity. Another such calamity would materially affect the value of all

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the property in the city, and the people should not rest until satisfactory measures are adopted and put in vigorous prosecution. The people as well as the city authorities have a duty to perform, and if we should neglect it, criminations and recriminations afterward would illy repay the loss. It is already one year this very day since the occurrence of the last great flood.

All of which is respectfully submitted.

D. C. HYDE,
W. H. GORSLINE,
A. CRAM,
D. W. POWERS,
HENRY L. FISH,
Committee.

Dated March 17, 1866.

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Hornellsville Report.

January 8, 1903.

Hon. Olin H. Landreth, *of Water Storage Com., Schenectady, N. Y.:*

Dear Sir.— Hon. F. J. Nelson, mayor of this city, and chairman of the local flood committee, has handed me your letter of the 5th instant, to him, respecting the statistics of damage sustained in this city during the year 1902 by reasons of floods that year, and has requested me to answer it.

It will be impossible for me to give you a detailed and itemized statement of such damages; but such damages are made up from damages to the streets, bridges, etc., this is damages sustained by the municipality; the damages sustained by the railroads, mills, factories, ice plants, truck gardens, dwellings, and other property, owned by corporations and individuals, are regarded as in the nature of private damages, and to the city as public damages.

Our local committee, after making quite a thorough investigation, and consulting with the persons so damaged, place such damages, both public and private, at fifty thousand dollars ($50,000), this is regarded as a very moderate and conservative estimate.

Yours truly,

I. W. NEAR,

Secretary of Hornellsville Flood Com.

The following photographs will show some of the flood conditions in the city of Hornellsville:

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Canisteo Flood Committee Report.

To the State Water Storage Commission, Albany, N. Y.:

We, A. M. Burrell, James A. Almy and John H. Consalus, comprising the Canisteo Flood Committee, respectfully report that we employed Col. Garrett F. Speer to see each man in the flooded district in Canisteo and ascertain the amount of damages he had sustained by reason of the floods of 1902. That he did so, and the damages each person has sustained was stated by and signed by the persons respectively.

We also employed him to make a map of that portion of Canisteo village that had been flooded during 1902; the same is hereto annexed and makes a part of this report. We were delayed in getting the amount of damages sustained by the Erie Railroad Company, but the same was furnished, and is hereto annexed. All of which is respectfully submitted.

Dated Canisteo, January 26, 1902.

A. M. BURRELL.
J. A. ALMY.
J. H. CONSALUS.

ERIE RAILROAD COMPANY,
ELMIRA, N. Y., *January* 22, 1903.

MR. A. M. BURRELL, *Attorney, Canisteo, N. Y.:*

DEAR SIR.— Replying to your letter of January 16th, in reference to flood damage in neighborhood of Canisteo, N. Y.

As near as we can locate, the amount of damage done this company by the floods of the past year in the territory between Adrian and Hornellsville is $18,955 for the emergency and permanent repairs to track and roadbed. In addition, the floods of the past year have demonstrated that our openings at Stevens

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and Cunninghams creeks should be enlarged. The estimated cost of this work will be about $13,466, or a grand total of $32,421.

Respectfully,

W. PRUDALL,
Superintendent.

HOUSE TO HOUSE ESTIMATE OF DAMAGE BY FLOODS DURING THE YEAR 1902, IN THE TOWN AND VILLAGE OF CANISTEO, STEUBEN COUNTY, N. Y.

L. A. Waldo, Farm.

125 acres flooded and crops destroyed, damage...		$2,000 00

(Signed.) L. A. WALDO.

V. A. Green, Farm.

60 acres flooded and crops destroyed, damage	$1,400 00	
3 acres flooded in village and residence damaged	100 00	
		1,500 00

(Signed.) V. A. GREEN.

O. B. Goff, Truck Farm.

10 acres flooded and crops destroyed, damage	$300 00	
Residence and fruit trees damaged.	50 00	
		350 00

(Signed.) O. B. GOFF.

Harry Burrell, Truck Farm.

16 acres flooded and crops destroyed, damage...		1,000 00

(Signed.) HARRY BURRELL.

E. J. Simpson, Farm.

10 acres flooded, pasture destroyed, damage	$100 00	
Barn and outbuilding damaged..	200 00	
		300 00

(Signed.) E. J. SIMPSON.

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J. I. Bennett, Farm.

18	acres flooded and crops destroyed, damage	$500 00	
	90 rods of fence destroyed	50 00	
	Land destroyed by washouts	100 00	
			$650 00

(Signed.) JOHN I. BENNETT.

S. A. J. Conkling, Garden.

3	acres flooded and crops destroyed, damage	$225 00	
	House and barn damaged	75 00	
			300 00

(Signed.) S. A. J. CONKLING.

Daniel Ordway, Farm.

17	acres flooded, meadow damaged	$200 00	
	Residence and garden damaged,	125 00	
			325 00

(Signed.) DANIEL ORDWAY.

M. D. Bunn.

12	acres flooded and crops destroyed, damage	500 00

(Signed.) N. D. BUNN.

F. Littell, Farm.

30	acres flooded and crops destroyed, damage	$450 00	
	Buildings and tools damaged	20 00	
			470 00

(Signed.) FREEMAN W. LITTELL.

J. P. Ordway, Farm.

70	acres flooded and crops destroyed, damage	$900 00	
	Land destroyed by washouts	1,000 00	
			1,900 00

(Signed.) J. P. ORDWAY.

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A. C. Johnson, Farm.

20	acres flooded and crops destroyed, damage	$400 00	
	Land washouts, fences damaged	100 00	
			$500 00

(Signed.) A. C. JOHNSON.

M. Allison, Farm, by W. F. Stewart.

25	acres flooded and crops two-thirds destroyed, damage	$500 00	
	Fences destroyed, damage	15 00	
			515 00

(Signed.) W. F. STEWART.

N. S. Crosby, Farm.

10	acres flooded and crops destroyed, damage	400 00

(Signed.) N. S. CROSBY.

D. F. Whitford, Farm.

15	acres flooded and crops destroyed, damage	$300 00	
	Land washouts, damage	300 00	
			600 00

(Signed.) D. F. WHITFORD.

W. J. Kinner.

12	acres flooded and crops destroyed, damage	$300 00	
	Land washed, building destroyed,	200 00	
			500 00

(Signed.) W. J. KINNER.

D. H. and Caleb Stephens, Farm.

18	acres flooded and crops destroyed, damage	500 00

(Signed.) CALEB STEPHENS.

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Matt. Stephens, Farm.

25	acres flooded and crops destroyed, damage	$700 00	
5	acres flooded and washed, fences destroyed	350 00	
			$1,050 00

(Signed.) MATT. STEPHENS.

H. M. Stephens, Farm.

10	acres flooded and crops destroyed, damage	$300 00	
3	acres flooded and washed, fences destroyed	140 00	
			440 00

(Signed.) HENRY M. STEPHENS.

Lida Hallett, Farm.

30	acres flooded and crops destroyed, damage	$500 00	
	Land washed, bridges destroyed	200 00	
			700 00

(Signed.) LIDA HALLETT.

H. W. Hallett, Farm.

30	acres flooded and crops destroyed, damage	$500 00	
	Fences destroyed, damage	10 00	
			510 00

(Signed.) H. W. HALLETT.

A. M. Baker, Farm.

50	acres flooded and crops, tobacco, hay destroyed, damage	$1,780 00	
12	acres flooded, washed and gullied, totally destroyed	2,000 00	
	Tobacco house and sorting house,	900 00	
	Hay in barn washed away	400 00	
	Fences and outbuildings	110 00	
			5,190 00

(Signed.) A. M. BAKER.

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J. Hartnett, Farm.

12	acres flooded and crops destroyed, damage	$500 00	
3	acres flooded, badly washed, practically destroyed	300 00	
	Fences destroyed	10 00	
			$810 00

(Signed.) JOHN HARTNETT.

A. O. Cornell, Canisteo Center.

	Lot, with buildings, tools, cider mill, all destroyed		800 00

(Signed.) A. O. CORNELL.

S. A. Hallett, Farm.

10	acres flooded and crops destroyed, damage	500 00

(Signed.) STELLA A. HALLETT.

Charles Moore, Truck Garden.

14	acres flooded and crops destroyed, damage	400 00

(Signed.) CHAS. MOORE.

Jeff. Hadley, Farm.

100	acres flooded and crops partially destroyed	$700 00	
	Fences destroyed	50 00	
			750 00

(Signed.) E. JAMESON.

Hiram Crosby, Farm.

75	acres flooded and crops destroyed, damage	1,500 00	
	Land washed, practically destroyed; fences	750 00	
			1,250 00

(Signed.) HIRAM CROSBY.

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James A. Stephens, Farm.

50	acres flooded and crops destroyed, damage	$1,000 00	
10	acres flooded and tobacco destroyed, damage	2,000 00	
20	acres flooded and badly washed, practically destroyed	500 00	
	Buildings destroyed	300 00	
			$3,800 00

(Signed.) JAS. A. STEPHENS.

Harriet Marshall, Farm.

30	acres flooded and crops destroyed, damage	$500 00	
	Buildings destroyed, damage	300 00	
			800 00

(Signed.) MRS. HARRIET MARSHALL,
Per HIRAM CROSBY, Agent.

Lewis Crosby, Farm.

55	acres flooded and crops destroyed, damage	$500 00	
20	acres flooded and washed, practically destroyed	1,000 00	
	Fences destroyed	50 00	
			1,550 00

(Signed.) LEWIS CROSBY.

Edward Baker, Farm.

25	acres flooded and crops destroyed, damage	$300 00	
4	acres flooded and tobacco totally destroyed	1,000 00	
			1,300 00

(Signed.) E. E. BAKER.

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Dr. Eli Sweet, Farm, by C. H. Morton.

20 acres flooded and crops destroyed..... $225 00

(Signed.) C. H. MORTON, Manager.

M. Davison, Farm.

60 acres flooded and crops destroyed,
damage $500 00
Fences destroyed, damage..... 50 00
550 00

(Signed.) M. DAVISON, by his farmer.

L. D. Rice, Farm.

44 acres flooded and crops destroyed,
damage $750 00
5 acres flooded and badly washed,
land destroyed 200 00
200 rod ditches filled..... 350 00
1,300 00

(Signed.) L. D. RICE.

H. Morse, Building Lots.

2 acres flooded, washed and filled, fences destroyed 500 00

(Signed.) H. MORSE.

Lydia B. Newal, Building Lot.

1 acre flooded and washed well, totally destroyed, damage 500 00

(Signed.) LYDIA B. NEWAL.

B. B. Babcock, Farm.

67 acres flooded and crops destroyed, damage... 1,300 00

Reported, but not signed.

John Willson, Farm.

87 acres flooded and crops destroyed, damage... 2,550 00

Reported, but not signed.

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F. H. Robinson, Farm.

100	acres flooded and crops destroyed...	$2,000 00	
	Land badly washed, ditches filled...	1,000 00	
			$3,000 00

Reported, but not signed.

Mrs Daniel Hadley.

30	acres flooded and crops destroyed...	$250 00	
6	acres flooded and washed, practically destroyed	500 00	
			750 00

The Floor Tannery.

Tannery flooded and fires put out, shut down three days, bark badly washed and destroyed, damage 2,000 00

(Reported.) FRANK FLOOR.

Canisteo Wooden Ware Company.

2½ acres flooded, occupied with factory buildings, and the storage of logs and bolts, plant shut down fifteen days, total damage..... 800 00

(Signed.) JOHN POWELL, Secretary.

American Basket Manufacturing Company.

2½ acres flooded, occupied with factory buildings and storage of logs, all badly washed and logs swept away, stoppage of plant, total damage 2,000 00

(Signed.) AM. B. CO. per White.

Alfred Slawson, Wagon Works.

1 acre covered with carriage factory, store house and lumber sheds, all badly washed and damaged, loss..... 500 00

(Signed.) ALFRED SLAWSON.

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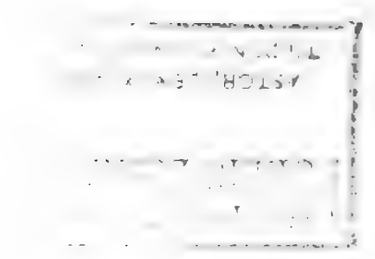

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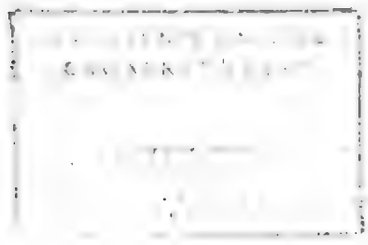
Maple Shoot, looking toward Cazenia River, Second Ward, Hornellsville, N. Y.—Flood of 1893.



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Urban Street, corner North Church Street, Broadalbin, N. Y.—Flood of 1902.

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Bridge over Canaseraga Creek on Church Street, Hemelleville, N. Y. —Flood of 1902.

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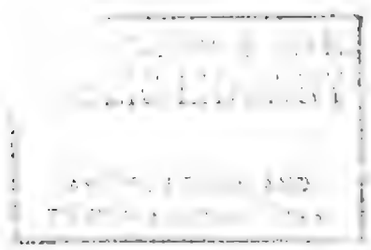
Looking down Purdon Street from Main, Hornellsville, N. Y.—Flood of 1902.



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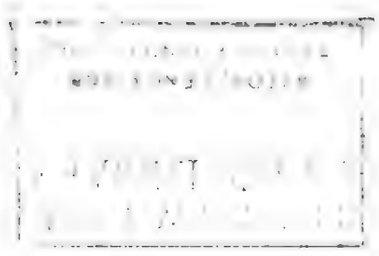
Riverside Place near Ellis Street, Third Ward, Harrisburg, N. Y.—Flood of 1865.



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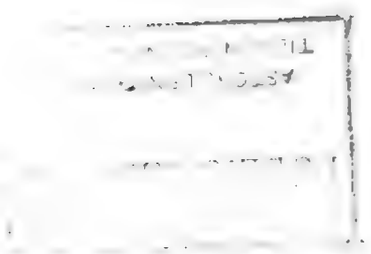
Lutheran Church, corner of John and Elm Streets. Between three and four feet of water in lecture room in basement.
Herkimerville, N. Y.—Flood of 1902.



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Tremont Place near Main, Dunellen, N. J. - Flood of 1903.

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Photo courtesy of Jack Hammond, Jr. '53 and Jeff Hall '87

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Fig. 2.1.2.1 – Ponte Vecchio, Florença, Itália

Corner of Fulton and Church Streets, Fayetteville, N. Y. — Dated 1841

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Main Street (east end), Brandisville, N. Y. — Flood of 1907.

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Gun Barrels in long-term Use - Rockhill, S. C. - Feed, d. 1865

Mid-Cross Town Cobblestoned Sidelines and Fountain Drive, Woodcliffe, N. J. - Proof of 1929

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Tour d'Argent, Paris, June 1968

Taylor Street, Canistoo, N. Y.—March Flood, 1902.

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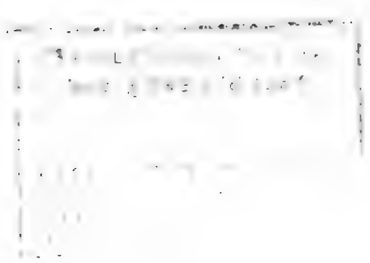
Mount Rainier National Park, Paradise Valley, 1920



Fort Macleod, looking toward Indian Woodsmith, N. W. Mounted Police

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Harbour View Lobster wharf, Pubnico and Lobster shack, Shoreline, N. S. - Postcard 1982

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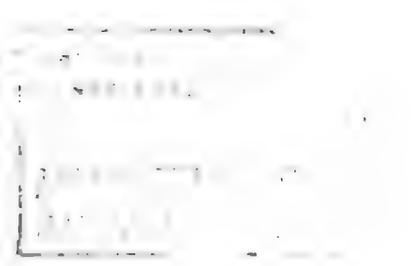
Town of Goldsboro Grand Ritual, June 1, 1909



Taylor Street, Canisteo, N. Y.—March Flood, 1902.

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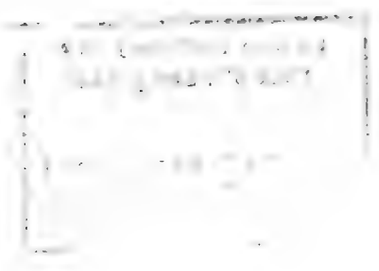
Scene on New Railroad just above Depot, Hankow, R. C. - Flood 8 August, 1931



Jews at Lincoln Court, E. 3 - Church Asylum, 1941 - Church and rabbis erecting tents of Yom Kippur

Canisteo Iron Works.

Moulding shops flooded, floors practically destroyed, damage $500 00

(Signed.) W. D. CARTER.

New York and Pennsylvania Railroad.

Trustle carried away, traffic impeded, damage, 550 00

(Signed.) G. R. BROWN, Receiver.

Supervisor, Town of Canisteo.

10	miles of wagon road destroyed, damage	$15,000 00	
35	bridges destroyed, aggregate damage	6,000 00	
150	rods of docking totally destroyed, damage	1,500 00	
			22,500 00

(Signed.) J. R. KEELER, Supervisor.

Street Commissioner, Village of Canisteo.

Street, sidewalks, crossings, ditches, damaged, 3,500 00

(Signed.) JOHN HUBURTEUS,
Commissioner.

Village of Canisteo.

320 dwelling houses, with gardens, destroyed, sidewalks destroyed and cellars flooded, damage 12,800 00

Ira Hall, Farm.

21	acres flooded and crops destroyed, damage	300 00	
	Residences and fences, including garden, damaged	150 00	
			450 00

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Erie Railroad Company.

Estimated damages as per special report attached	$32,421 00
	$117,421 00

I hereby certify that I have visited every individual flood sufferer along the Canisteo river, within the town limits, and received their individual signatures, for the amounts herein stated.

G. F. SPEER,
Enumerator.

Sworn to before me this 24th day of January, 1903.

C. C. BURRELL,
Justice of the Peace.

Here are a few Canisteo flood photographs. Two hydrographic maps of the Canisteo river and valley through the city of Hornellsville and the village of Canisteo will be found in Appendix No. 6, forming Plates VI and VII. A map of the village of Canisteo showing the portion usually inundated will be found on Plate VIII.

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Elmira Report.

January 7, 1903.

Mr. Olin H. Landreth, *Member of State Water Storage Commission, Schenectady, N. Y.:*

Dear Sir.—Your letter of January 5, 1903, received. I am sending you to-day, by Adams Express, tracings of the Francis Collingwood hydrographical map of the June and November floods of 1889, also blue-print of the city of Elmira, showing the approximate flooded districts of March 1, 1902.

It is impossible for me to give you an estimate of the money damages caused by the flood, as a large portion of the territory is composed of residences where the damage would be in some cases simply the cost of cleaning the cellars, other cases provisions, vegetables and canned fruit, etc., stored in the cellars were entirely ruined, this loss to many of the families who are people of moderate means and the laboring class is a very serious one. Some of the business houses' losses ran into the hundreds of dollars. Some of the manufacturing concerns were very heavy losers. The city suffered much damage to streets, crosswalks and sidewalks. Some of the sewers were also damaged. Considerable sickness followed the flood in the several districts.

Respectfully yours,

LEON D. CONKLING,

City Engineer.

January 17, 1903.

Prof. Olin H. Landreth, *Member of State Water Storage Commission, Schenectady, N. Y.:*

Dear Sir.—In reply to your favor of January 12, 1903, I herewith send you an approximate estimate of the money damage

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to the city of Elmira caused by the flood of March 1, 1902, as one hundred and fifty-five thousand dollars ($155,000).

Respectfully yours,

LEON D. CONKLING,

City Engineer.

Plate IX of Appendix No. 6 contains a map of the city of Elmira, showing flooded districts.

Plate X contains a map of the Chemung river through the city of Elmira.

Plate XI contains flood profile along main channel of Chemung river through Elmira.

Plate XII contains flood profile along main channel of Chemung river through Elmira.

Plate XIII contains flood profiles along north bank and also along south bank of Chemung river through Elmira.

Obion, S. T. — Weatherboarded cabin giving its former use as prisoner in Fort Randal about mid-war.

Hon. E. C. Hoyt and Miss Hoyt in front of their home in Bad Axe.

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Vista, P. 1 - Vestiaire des Abattoirs Ecrin - Fond d' Mur

THE NEW YORK
PUBLIC LIBRARY
ASTOR, LENOX AND
TILDEN FOUNDATIONS.

Plate V. Sandstone from Shawnee River. (Reid & Hill)

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Olean Report.

OLEAN, N. Y., *January* 17, 1903.

Prof. O. H. LANDRETH, *Member Water Storage Commission:*

DEAR SIR.—I send you herewith, under separate cover, a map of Olean to scale 400 feet per inch, which shows approximately the high water line of flood of March 1 and 2, 1902.

That portion of the flood near the north end of Union street was from Olean creek, which was apparently held back by railroad embankment or other obstructions. The flood in south part of city was from Allegany river direct.

There were about 280 houses, including several business places, which received more or less damage from high water. Damage was principally from flooded floors and cellars, washing away of surface soil and making gullies in streets and private grounds, loss of sidewalks, etc. The total amount of loss is hard to estimate, but I should place it at from $4,000 to $6,000 for this flood. Total number of inhabitants discommoded, from 1,200 to 1,500. I also send photographs as follows:

Two marked A and B on back show the Mayer house with piling, on Barry street, near river.

One marked C shows Barry street looking south from Green street, Mayer house in distance.

One marked D shows Union street looking south from Green street. Water pumping station across the river, in distance.

The last two, C and D, were taken March 1, 1902, when water was about one foot below its highest point during this flood.

Respectfully,

E. E. ALLEN,
City Engineer.

Following are the photographs referred to in the above communication. The flood map of the city of Olean forms Plate XIV of Appendix No. 6.

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Buffalo Flood Committee Report.

CITY OF BUFFALO, MAYOR'S OFFICE,
February 6, 1903.

OLIN H. LANDRETH, Esq., *Water Storage Commissioner, Albany, N. Y.:*

DEAR SIR.—As chairman of the local committee having in charge the matter of investigating the question of floods, I send you herewith further maps relating to South Buffalo floods, together with full and complete data regarding the same. These maps and data were transmitted to me to-day by Mr. Charles M. Morse, Deputy Engineer Commissioner, and they have the approval of the local committee.

Trusting that this report will be of assistance to the commission, and that it will also aid in relieving conditions in Buffalo, I remain,

Very truly yours,
ERASTUS C. KNIGHT,
Chairman Local Flood Committee.

BUFFALO RIVER AND CAZENOVIA CREEK,
February 6, 1903.

THE WATER STORAGE COMMISSION, *Office, Capitol, N. W. Corner, Fourth Floor, Albany, N. Y.:*

GENTLEMEN.—In pursuance of instructions from yourselves to the local committee appointed by you in the matter of the study of flood conditions affecting the City of Buffalo, due to overflow of the natural waterways in time of freshet, your local committee has gone ahead with the investigations and studies necessary to an intelligent presentation of conditions existing in Buffalo river and Cazenovia creek, the two waterways which

separately and combined affect most seriously the district commonly referred to as South Buffalo.

Considerable data has been secured in the past by the Bureau of Engineering of the city of Buffalo, and this data, together with that obtained from recent floods, we have endeavored to put in such shape that your commission might use it to advantage in reporting upon this particular locality.

The present condition is very serious and expensive to the residents of South Buffalo, and is becoming more so in the natural course of events.

Floods over a farming country, especially one largely devoted to gardening are not entirely calamities, and at one time most of the territory now seriously affected within the city limits might have been classed under that heading.

It does not appear that the actual flood conditions are any greater to-day than they were at different periods from 20 to 35 years back, although it would seem reasonable to suppose, and probably it is a fact, that the denuding of the slope of the upper course of the streams has materially increased the maximum discharge and equally decreased the minimum.

Probably the reports on floods of a number of years ago did not take into account the differences in levels of Lake Erie, which, together with the lack of any protection from overflow of the lake waters, undoubtedly affected flood conditions.

The area actually flooded in case of freshets is about 1,600 acres, which, at present, contains a population of about 10,500, in which the assessed valuation of lands is about $5,000,000 under present conditions.

Accompanying this report are maps and diagrams showing the flooded areas in the city and the watershed, which is the source of the waters, and other data pertaining to the subjects.

The work now proposed by the Department of Public Works to abate floods within the city limits is the construction of channels which are, to some extent, on the lines of the old channels, and to some extent are new alignment, the whole resulting in an alignment which straightens the original course of the streams as far as practicable and lowers the flood elevation at the entrance of the waters into the city.

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The following is the substance of a report to the Department of Public Works on the hydraulic problems connected with the abatement of floods of Buffalo river and Cazenovia creek within the limits of the city of Buffalo:

REPORT.

On the hydraulic problems connected with the abatement of floods of Buffalo river and Cazenovia creek within the limits of the city of Buffalo.

The general problem is that of a stream carrying a fairly well-known amount of water in flood, entering the easterly line of the city at a point about 18,000 feet distant from Lake Erie, flowing mostly in an alluvial valley, and joined by a branch one-half its size, which descends from a higher rocky bottom, the two overflowing at intervals a territory of from 1,200 to 1,600 acres, containing a population of about 10,000, and with a flood slope of from 16 to 20 feet in the above distance.

To prevent the overflow of the banks of the streams is the problem, and this can be accomplished by reducing the flood slope one-half or one-third.

In general the result may be accomplished in two ways:

First.

Reducing the amount of water entering the city.

Second.

By providing a better outlet channel within the city.

The first may be accomplished by diverting a portion of the flood flow to another channel outside of the city, or by impounding a portion of the flow at maximum discharge, thereby reducing the maximum flow through the city.

These methods have been studied, and all the conditions governing the situation seem to combine to discourage any such attempts to accomplish the desired object.

The probable cost of impounding or storing the flood waters so as to control the amount of maximum discharge into the city is as great as the cost of providing within the city limits a channel of sufficient capacity to take care of the maximum flow.

The location of such works outside of the city's jurisdiction would seem to argue against the attempt by the city to execute the same, even if such works could be shown to be reasonably feasible, and it does not appear that such is the case.

The second method, by providing a better outlet channel within the city, seems to be the most reasonable as a work to be assumed by the city because, in the first place, the location of the improvements is within the corporate limits and entirely under the jurisdiction of the city, and, in the second place, is the most efficient from an engineering standpoint.

Another advantage that is quite apparent to the owners of lands that will be enhanced in value, is the resultant water frontage on what will necessarily be a navigable waterway.

The flood elevation is to be at once lowered eight or ten feet, and the flood discharge carried on this flattened slope to an outlet into Lake Erie.

The points here presented for consideration are four:

First.

The quantity to be carried.

Second.

The available outlet.

Third.

The channel required to carry the given flow with the slope desired.

Fourth.

The means of lowering the flood waters from their present level to the desired level at or near their entry into the city.

First. The quantity to be carried:

Recorded observations of flood heights and discharge of this stream were first made by the Bureau of Engineering in 1893, and have been more or less complete since that time.

In January, 1898, Mr. C. H. Tutton, then, as now, an assistant engineer in the Bureau of Engineering, made a report on this subject to the Board of Public Works, and the following is quoted from such report:

"The distance from the headwaters of Buffalo river to its outlet in Lake Erie is approximately 50 miles, 9 miles of which lies in the city of Buffalo, and but two miles of which, reaching back to Hamburg street, is regulated. The remaining seven miles within the city (unregulated) follows a very tortuous course, and it is this portion that it is proposed to regulate * * *."

"About 6¾ miles from its outlet it is joined by the Cazenovia creek, whose total length is about 26 miles, and whose main affluent is about 16 miles long. About 10 miles from its (Buffalo river's) mouth it is joined by the Cayuga creek, whose length is about 39 miles.

"The watersheds of these different streams, as determined from a map on a scale of 2½ miles to the inch, are as follows:

	Sq. miles.	Sq. miles
Cayuga creek	127	
Buffalo river	145	
		272
Branch of Cazenovia creek	54	
Cazenovia creek	87	
		141
Buffalo river below junction		413

"A copy of such map is presented herewith.

"The Cazenovia creek passes through a mountainous region, and its flood height at Buffalo is soon reached and quickly passed, its greatest height being reached 3 to 6 hours before the flood waters of Buffalo river appear.

"Its 140 square miles of watershed gives an approximate maximum flood discharge of 8,000 cubic feet per second, as determined by different formula, some of which take into account the shape of the watershed, and others not; and by comparison with recorded flood discharges of similar rivers.

"The Buffalo river with its 270 square miles of watershed has an approximate discharge of 17,000 cubic feet per second, determined in the same manner. The highest flood of which there are records are those of May 20, 1894, March 30, 1896, and January 13, 1898. The flood of December 16, 1893, reached higher points west of Abbott Road bridge — due to ice gorges. Rough

discharge observations were made at the foot of Hamburg street during the floods of 1896 and 1898. The surface velocity was measured by means of floats, and, in order to ensure a maximum, 85% of this was taken as a mean velocity. The stage varied considerably at this point, even at maximum discharge, as continuous dredging operations and enlargement of channel were going on.

"The actual measured discharge in 1896 was 18,427 cubic feet per second.

"The actual measured discharge in 1898 was 18,669 cubic feet per second.

"As neither of these was taken at the highest water, it was estimated from these that

Maximum high water discharge of 1896 was 20,640 cubic feet.
Maximum high water discharge of 1898 was 19,260 cubic feet.

"From this data, and from gauge readings, it is estimated that the maximum high water discharge in 1894 was 22,000 cubic feet per second."

Mr. Tutton further discussed the question in his report from measurements taken at up-stream points during the two floods and found a very substantial agreement as to discharge.

It is to be noted in the above that while the maximum discharge of Buffalo river above the junction is taken at 17,000 cubic feet per second, and of Cazenovia creek at 8,000 cubic feet per second, the combined discharge is assumed at but 22,000 cubic feet per second, or 3,000 cubic feet below the sum of the two. This is due, as noted, to Cazenovia creek reaching its maximum from 3 to 6 hours before Buffalo river, the discharge of Cazenovia creek falling to about 5,000 cubic feet at the time Buffalo river reaches its highest stage. Deviations from this will be mentioned in connection with the flood of March 1, 1902.

In 1898 plans and specifications for the improvement of these streams by deepening and widening the same on their present lines were prepared, and bids were received upon the work.

That plan, known as "Plan A," was submitted to Rudolph Hering, M. Am. Soc. C. E., as expert, and in his report upon the same, dated July 24, 1899, he says, regarding above discharge figures:

"These figures, obtained from data pertaining to local conditions, are approximately confirmed by actual observations made on other streams."

The following table contains a few observations on streams which are to some extent comparable with Buffalo river:

Stream.	Watershed.	Total flow cu. ft. per second.	Rate Cu. Ft. per second per Sq. Mile.
Buffalo river above junction	272	17,000	62.5
Cazenovia creek	141	8,000	56.7
Buffalo river below junction	413	23,000	55.7
Perkiomen, Pa.	152	10,518	69.2
Croton, N. Y.	339	25,300	74.9
Ramapo, N. J.	160	10,540	66.1
Fall Creek, N. Y.	117	4,800	41.0

It will be seen that the assumption of flood-flow for the Buffalo river below the junction with Cazenovia creek is less than for the Croton river with a somewhat smaller watershed. Yet this may not be inconsistent, as it is well known that the heavy rain storms are greater, and thus produce greater floods, on the Atlantic slope of the Alleghany Mountains than on the western slope. The same may be said of the Perkiomen and Ramapo floods. On the other hand, the floods of these three rivers come from territory that is not likely to be cultivated to the same extent as the drainage area of Buffalo river and, therefore, in proportion, they are not likely to yield as great floods."

Floods since the above records have added but little information up to the past year. The flood of February 9, 1900, reached a very high stage in the lower portion of the river, due to a westerly gale, together with an ice and boat jam. These will be mentioned under their proper heads. The probable maximum discharge was 18,000 cubic feet per second.

On February 28, and March 1, 1902, there occurred a flood which produced the largest measured discharge, and reached the highest general level of overflow on the upper reaches of the streams within the city.

(Note record of precipitation and temperature.)

Unfortunately, the flood came sooner than my observation of the upper course of several similar streams on the 28th led me to expect.

Arrangements are made in such cases to establish observers at several different points, but some were not aware of the conditions until A. M. of March 1. However, two fairly continuous sets of gauge readings, one at the head of navigation, and the other near the center of the flooded area at the junction of the two streams were obtained, and with the United States Engineer's recording gauge near the mouth, give a fair idea of what occurred. (Profile, flood slope.)

The slope of this flood (and others) is shown upon the accompanying diagrams of flood heights. The gauge heights at various points are shown upon the gauge diagrams for this flood, the dotted lines being interpolations from adjoining gauges and high water marks. The lower curve is from the recording gauge situated in the U. S. Slip opposite the junction of Buffalo river and City Ship Canal, about 1,000 feet above the mouth of the river.

Float tests for discharge were made on a straight section of the river above Ohio street. This section is 880 feet long, has a crib dock the whole length on one side, and for about 400 feet on the other, the remainder of this side being unimproved bank. The nominal depth is 19 feet, excavated for about 10 feet in rock, but the average depth is 20.5 feet to rock. This section was comparatively free from silt before the flood, but afterwards was found to have an average depth of 18.4 feet. How much of this silt was deposited before the flood tests were taken cannot be told. The assumption used is that much of the silt was deposited on the falling stage, and after the tests were made, or that silt had smoothed up the rough bottom to give an average depth of 19 feet at mean water, or elevation — 22.0 feet. (Mean water level = 3.00 feet.)

The section was used immediately below a bend in the channel of about 120 degrees to the left, and is followed at its lower extremity by a sharp bend to the right, hence the maximum current is found about 40 feet out from the right bank (all going down stream), or northerly side. This is further accentuated just below this section by the Ohio street bridge which has its greatest

opening on this side of the stream. The thread of the current being so much to one side of this section has been one reason for assuming the mean velocity as only 80% of the measured maximum surface velocity as against 85% assumed by Mr. Tutton, with the belief that this errs on the safe side, or is rather larger than the truth.

The maximum flow in this flood probably occurred between 1 and 3 A. M. of March 1.

Float tests over this course taken February 28, 5.53 and 6.15 P. M., were as follows:

Time.		
Minutes.	Seconds.	Date.
3.....	20.....	Orange
3.....	20.....	Orange
3.....	17.....	Ice
3.....	35.....	Orange
3.....	26.....	Ice

Average of 5 floats 3 minutes 25½ seconds, maximum surface velocity 4.30 feet per second, mean velocity 80% of maximum, 3.44 feet per second, area 4,207.5 square feet, quantity 14,474 cubic feet per second.

At this time a very heavy fall of ice was passing. It occupied most of the width of the stream and was grinding against the northerly dock.

As these floats were traveling but about 40 feet out it seemed quite probable that the ice and other floats were materially retarded by such shore friction.

It is further the opinion of the writer that with any heavy surface flow of drift or ice, the actual position in the depth of the maximum velocity line is materially depressed. Neither in this or the following test was there any perceptible wind to affect the floats.

The following morning, March 1, the following float tests were taken, all being oranges:

Between 9.20 and 9.30, 4 floats. Time, 2 minutes, 14 seconds; 2 minutes, 23 seconds; 2 minutes, 23 seconds; 2 minutes 18 seconds.

Average, 2 minutes, 19½ seconds; maximum surface velocity, 6.31 feet per second; mean velocity at 80% 5.047; depth of water, 21.00 feet; quantity of discharge, 23,847 cubic feet per second.

Between 9.40 and 10.23 A. M., 8 floats, time, 2 minutes, 29 seconds; 2 minutes, 28 seconds; 2 minutes, 22 seconds; 2 minutes, 31 seconds; 2 minutes, 30 seconds; 2 minutes, 28 seconds; 2 minutes, 24 seconds; 2 minutes, 31 seconds; average, 2 minutes, 28 seconds; maximum surface velocity, 5.94 feet per second; mean velocity at 80%, 4.75 feet per second; depth of water, 20.7 feet; quantity of discharge, 22,123 cubic feet per second.

Oranges have proven the most satisfactory of anything tried for surface floats. They are easily placed, readily seen, and offer but slight resistance to the wind.

No degree of refinement has been attempted, but the above is believed to be a reasonably true record of actual conditions.

It has not been considered desirable to use further refinements, unless an elaborate series of observations were to be undertaken.

In this narrow, crooked stream, affected by constantly varying ice or drift flow, or jams, where the water height is at all times subject to great variations due to those in Lake Erie, and affected by the movement of boats, any attempt at accuracy would require considerable preparation and extended observation; more than would be warranted for the results desired; when the other limitations of the problem are considered.

From the above observations the probable discharge at maximum stage has been computed by the usual rule $\frac{Q}{q} = \frac{A\sqrt{R}}{a\sqrt{r}}$

This gives for the various sets of floats:

First, 18,150 cubic feet per second.

Second, 25,700 cubic feet per second.

Third, 24,300 cubic feet per second.

It has been noted above that the first series of floats was materially interfered with by floating ice, and that may account for the discrepancy in computing the maximum from it.

It is believed that an average value from the second and third sets of 25,000 cubic feet per second is reasonably fair.

This flood was co-incident with other unusual floods in this section.

It arose from the melting of a heavy body of snow, which had been on the ground for some time. The run-off began as soon as the accumulating waters begin to cut their way through the hard snow. It seems probable that the conditions favored a flood of longer duration than usual, and that Cazenovia creek, while reaching its maximum three or four hours earlier than Buffalo river, held such maximum flow until the latter also reached its maximum.

If this be true, then the former assumption that the respective maximum discharges were 8,000 and 17,000 cubic feet per second, gives a combined discharge as found above.

Observations of the conditions on the upper portion of these streams within the city, has, for some time, inclined the writer to the opinion that these streams are nearly self-regulating, and that their greatest delivery to the city is nearly a constant quantity.

Another element enters into the estimate of discharge as made from measurements on the lower sections of the river. In 1902 an area of about 1,600 acres was overflowed within the city. This represents storage at or near the maximum discharge.

A rough approximation gives 1,100 acres north of Abbott road overflowed to an average depth of 2 feet, or 95,832,000 cubic feet, and 500 acres south of Abbott road overflowed to a depth of 3 feet, or 65,340,000 cubic feet, a total of 161,172,000 cubic feet, equivalent to 1 hour, 47 minutes discharge of the stream at the above assumed maximum of 25,000 cubic feet per second.

Much of the unimproved territory north of the Abbott Road is filled up at an early stage of a flood, while that lying south of the road can only be filled when water reaches the height of the road, excepting a small amount entering along the railroad ditches.

As it takes several days to empty the pond through these ditches they are here neglected.

Some study has been given to this question, but as yet no satisfactory solution has been reached.

The result of one is given with much hesitancy, as it appears quite unsatisfactory. The method was as follows:

The assumption was made that the area north of the Abbott road had a uniform rise away from the river, that the overflow

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began when a height of +5.0 was reached at Seneca street, and that the quantity of overflow was proportioned to the gauge height above +5, that is for +6, 1, for +7, 2, for +8, 3, etc. The total overflow was then divided into parts proportional to these figures and the time taken for each such increment of height, and the overflow for such time divided by the time elapsing for each foot increment in height, assuming that the overflow ceased when the gauge readings began to decrease.

The overflow south of the Abbott road was similarly treated excepting that, as it was more in the nature of a weir flow, the weir increasing in area with the depth, the total overflow was proportioned into the squares of the increments of height at the Abbott road bridge gauge, and the overflow was assumed to continue in a decreasing amount as long as the water was above the road level. It is probable that this latter solution is much further from the truth than the former.

The diagram shows a discharge curve based on a discharge of 23,000 feet per second at Hamburg street at 10 A. M., March 1, 1902, and the corresponding heights at that point.

A dotted curve is also plotted showing the same, taking into account the slope above Hamburg street around Farmer's Point.

A similar curve was also computed, using the slope below Hamburg street, but the effects of the varying heights in the lake seemed to make it entirely useless.

Above the discharge curve are shown the additions due to the two overflows, computed as above described.

This gives a maximum entry of water into the city of 29,800 cubic feet per second, or an increase over measured amount of 18%. It is very questionable.

But supposing this to be true for the largest flood of which we have no records; no other flood having a larger measured discharge than about 20,500 cubic feet per second has occurred in 8 years.

If the unknown effect of overflow be assumed even at 18% addition to the flood discharge of 20,500 it would produce but 24,190 feet discharge, while the channel has been computed at 25,000 feet capacity.

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If this additional quantity be put in the channel at the junction without increased velocity, it would produce about 4.4 feet raise over computed height, while this increased velocity, due to increased slope, it probably would not exceed 3 feet raise, or a flood height of +6, which would produce a very slight overflow.

With a possibility of such occurrence once in 10 years it does not seem wise to make extra provision for it.

ELEVATION OF OUTLET.

This has been quite thoroughly discussed previously, and reference is given to the report of the Bureau of Engineering of this city for 1898 at to probable lake levels.

But two points will be taken up now. The regulation of the water level of Lake Erie, as proposed in the report of the Deep Waterways Commission of 1896, was at an elevation of —1.11 city datum or 1.89 feet above our assumed mean water.

This, by the back-water curve elsewhere referred to, would produce a rise of 0.90 feet at the junction of the creeks, and need not be a source of serious difficulty.

The effect of ice in the outlets of the stream is of large importance. While with a deepened channel it will be quite possible to prevent serious ice jams by means of our efficient ice breaking fire-tugs, it is not always possible to keep an open outlet.

The path of the ice passing out of the mouth of the river is uncertain. With no wind, or wind not in a southwesterly direction, it is possible to keep an open outlet for the ice to reach the open water at the head of Niagara river.

With a strong southwesterly wind the broken ice around the mouth of the river is driven in and at once closes any outlet channel made.

The effect of the new breakwater and of the improved channel toward Black Rock harbor are undetermined quantities.

The effects of gales and ice obstructions in the lower portion of the river are of as much concern to that portion as to the flooded area.

While this portion of the river may be deepened somewhat, it will always remain an unsatisfactory outlet for large discharges of water and ice.

It is obstructed by bridges and by the many vessels moored along it.

It probably will not be widened, as other developments will accomplish the result in a more satisfactory way.

The separate outlet to the lake at the point proposed seems so desirable that only unforeseen obstacles should stand in its way.

It was intended to show some of the causes which led to several large vessels in the lower river breaking from their moorings on February 9, 1900, doing much damage to themselves and to bridges, and after forming an obstruction with the flowing ice, which produced the highest flood elevation of years along the lower portion of the unimproved river. Space does not permit, but it may be said that such disasters cannot well be prevented if not other outlet is provided.

The proposed cut into the lake should be of importance in the plan in providing an outlet elevation for the proposed improvement about 3 feet lower than the present. This outlet entering the protected area inside the breakwater may not be able to carry any large amount of ice, as it will probably jam up against the heavy ice in the harbor, but even when completely jammed with ice it will provide a partial outlet for flood flow which will lessen the danger of a serious back water from obstructions in the old channel.

3 *The channel required to carry the given flow with the slope desired.*

Frictional resistance of the proposed channel is, of course, the principal element in lowering slope. Under the present knowledge of hydraulics it is also the best determined.

A new channel constructed in the same material as the old, and subject to the same conditions as the old, should not show material differences in friction.

To approximate to this 15 cross-sections of the stream were plotted, the first being 2,000 feet above Hamburg street, and the others taken at uniform distances of 1,000 feet apart, giving average sections for most of the river below the junction.

The partial flood of January 5, 1899, which had a discharge of 10,600 cubic feet per second, measured as above described, was taken as a bank full flood.

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The elevations of water surfaces as determined at several points was plotted on the sections, the area, perimeter and velocity computed. In three sections allowance was made for overflow outside of channel.

The slope was computed between the various points of known surface elevation.

As the section varied in form and area, it is evident that the slope could not be uniform.

As an approximation, the resistance due to bends was considered to be uniformly distributed along the whole distance, and the slopes corrected for the amount due to resistence of bends.

Further, it was assumed that the remaining slope for each section would be inversely proportional to the hydraulic radius.

The net fall between any known elevations after bed resistence was deducted, was then proportional to each section in inverse proportion to the hydraulic radius of such section.

With this corrected slope, the value of C was computed in the formula $V = C \sqrt{R} \sqrt{S}$ and from the values of C, R and S the value of N in the Kutter formula was determined by diagram. This gave values as shown on the accompanying table, varying from .0205 to .0304, but 9 out of 15 determinations lie between .022 and .025, the average being .0238, while a value derived from mean values of C, R and S give .0236.

This value may be considered low, but this may as well be due to an overestimate of the quantity of discharge.

As the measurement of quantity was by the same method and on the same section as the measurements for maximum flow, the above would seem to give a fair value on which to compute the new channel.

A value of N equals .026 has been used for computation of new channel, which seems quite within safe limits.

Station.	Q	A	V	R	S	C	N
1							
2	10,600	2,390	4.44	8.82	.000285	89	.0242
3	10,410	2,097	4.96	9.20	.000250	103	.0210
4	10,600	2,367	4.48	7.52	.000346	87	.0235
5	10,330	2,149	4.62	9.62	.000248	95	.0228

Station.	Q	A	V	R	S	C	N
6	10,600	2,475	4.28	7.62	.000348	83	.0252
7	10,570	2,315	4.54	7.15	.000367	89	.0231
8	10,600	2,023	5.23	12.58	.000150	97	.0237
9	10,600	2,876	3.68	9.17	.000297	71	.0304
10	10,600	2,596	4.18	8.35	.000314	82	.0261
11	10,600	2,395	4.42	9.86	.000247	90	.0245
12	10,600	2,340	4.53	7.84	.000327	89	.0237
13	10,600	2,180	4.86	9.58	.000240	101	.0214
14	10,600	2,230	4.75	10.02	.000230	99	.0220
15	10,600	2,115	5.01	9.56	.000235	106	.0205
16	10,600	2,430	4.37	12.92	.000171	93	.0250
Average	.....	.....	....	.....	.....	....	.0238
From means		.....	4.56	9.32	.000261	92.2	.0236

If it be assumed that the size and grade of the channel have been correctly computed so as to produce a uniform flow with the assumed greatest discharge and given elevation of lake, it is apparent that any change in the elevation of the lake or any local obstruction, such as an ice jam, will produce a change of surface elevation extending indefinitely up stream from such outlet or obstruction.

No investigation of the extent of such change of surface slope has been made by any back-water formula, but sometime ago a constructive solution of the question was made. This was based on an improved channel along approximately the present lines of the stream. In this a uniform flow was assumed as constant at a depth of 20 feet and a mean width of 220 feet, with a quantity of 22,000 cubic feet per second computed on the Kutter formula to give a certain grade. This grade was then increased by the amount of slope necessary to overcome the resistance at the given velocity, due to the curvature. The assumption was then made that the discharge level charged by uniform increments, from the normal depth of flow of 20 feet to a lower elevation giving a depth of 16 feet of water, and to a greater elevation giving a depth of 24 feet of water in the channel at its outlet.

The resulting velocities for a constant quantity of discharge were then computed for the various areas, and then a slope computed in each case which would produce such velocity with the resulting section of channel. These slopes are shown on diagram plotted for N equals .025, and N equals .030 in the Kutter formula, such slopes also carrying that necessitated by the curvature.

The depths are the abscissa, and the corresponding slopes the ordinates. A straight line is drawn at the slope elevation corresponding to uniform flow at a depth of 20 feet.

From this diagram backwater curves were constructed as follows:

A depth of 16 feet being assumed at outlet, the difference in ordinates or slopes between the normal depth of 20 feet and 16 feet or between the slope curve for N equals .025 and the horizontal through the normal slope, is seen to be 0.23 feet. This represents the convergance of the two slopes in 1,000 feet, or at the end of the first 1,000 feet up stream there would be a depth of 16.23 feet.

Again, entering the diagram with depth of 16.23 feet the corresponding differences of slope is found to be .21 feet for the next 1,000 feet. This gives a total depth of 16.00 + 0.23 + 0.21, equals 16.44.

This is repeated each time adding the ordinates to the last abscissa for a new abscissa.

These depths plotted above the assumed bottom grade give the backwater curve.

A similar construction is shown, assuming the outlet depth to be 24 feet.

In a similar manner the effect may be investigated should the channel be computed to a slope based on N equals .025, and in fact should prove to be N equals .030 by taking the difference in ordinates between the slope curve for N equals .030 and the normal grade for N equals .025 for depths increasing from 20 feet. The errors in the above assumptions of a constant grade for 1,000 feet do not materially affect the resulting curve.

As the present channel from Hamburg street to the lake does not differ materially from the above assumed channel, it may be included in this study.

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The distance from the lake to Hamburg street is 10,800 feet, from Hamburg street to the junction of Cazenovia creek, 13,800 feet, total 24,600 feet.

From the diagram a rise of 4 feet in lake level will produce a rise at junction of 2.1 feet, N equals .025, a rise of 3 feet, 1.5 feet.

With the cut-off to the lake made as planned, the outlet level would be —3.0 instead of +1.0 as now computed, or a lowering of 4 feet. This, from diagram, would produce a lowering of 2.0 feet at the junction, and if the channel were of the same size, a lowering at the city line of 1.4 feet, but as the channel is narrower above the junction the difference would be less than this.

Should the coefficient of roughness prove to be .030 instead of .025, the resulting elevation at the junction would be increased but 0.7 feet, while the effect of a rise of 4 feet in the lake level would be but 1.65 feet, so that the resulting water level would be but 0.25 feet higher at junction under these conditions.

Similarly, from the diagram the effect at various distances above an ice jam or other obstruction producing a certain rise may be determined.

4 *The means of lowering the flood waters from their present level to desired level at or near their entry into the city.*

Cazenovia creek improvement terminates in the rock ledge below the Cazenovia street bridge. This rock bottom is 7 feet to 8 feet above mean lake level. About 800 feet above the termination of the improvement is situated a dam forming a lake in Cazenovia park. It is proposed to carry the improved bottom grade into this rock ledge, forming a water fall entirely in rock.

Some protection to the banks at or below the fall is the only work which will be necessary at this point.

On Buffalo river at the city line the conditions are entirely different.

The river above the city line appears to be somewhat similar to Cazenovia creek on its lower portion. At the junction of Buffalo and Cazenovia creek, about 4,000 feet in a direct line above the city line the creek is on a rock bottom, which is about 8 feet above the bottom at the city line.

This distance measured along the stream is 7,200 feet. Apparently there is much erosion of the banks, which are of alluvial deposit with but slight resisting power.

In several places the channel shows a tendency to cut across necks. The adjacent land is the garden of the city.

Should the proposed improvement and lowering of the flood height be carried to the city line and no provision made to prevent such trouble, it seems most probable that the city would be confronted with two serious conditions at once.

The increased fall would increase erosion and bring large quantities of silt to be deposited in the channel, sufficient to soon impair its carrying capacity. The other and more serious result would be the increased erosion of banks, which would result in a lengthening of the channel and the destruction of much land along its banks.

For these two reasons prevention of undue silting in improved channel and of damage to lands above, it has been deemed absolutely necessary to preserve, as nearly as possible, the existing conditions beyond the improvement.

For the protection of lands within the city it is necessary to confine the broad overflow sheet at this point to the limits of the new channel, which will be accomplished by filling the lands immediately within the city to a greater elevation than reached by any flood.

From the data available, the following have been assumed as the governing conditions:

First.

Dry weather flow to be accommodated at present elevation.

Second.

A discharge of 8,000 cubic feet per second to be let down from an elevation of +10 above to +1.0 in the improved channel.

Third.

A discharge of 18,000 cubic feet per second to be let down from an elevation of +15.0 above to +5 in the improved channel.

Fourth.

An opening of sufficient width to pass ice should be provided, equal to the present channel width of about 110 feet.

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For the first condition an overflow at elevation of —3.0 or present bottom elevation, is required. It has been assumed that a length of weir of about 15 feet is sufficient for this.

If the whole weir length were of this elevation, it would require a length of but 72 feet.

If the weir were 110 feet long of this elevation it would produce a lowering of about 4 feet in full flood and more than this at 8,000 cubic feet per second discharge.

It may be said here that the details of this work have not as yet been worked out, and the figures given are derived from the simplest expressions for weir discharge, $Q = ch, \sqrt{2gh}$ for discharge per foot length of submerged weir, and $Q = C\ 2/3\ h\ \sqrt{2gh}$ for elevations above backwater, h1 being the submerged depth of weir, h the approach height above weir, or above backwater where submerged; C being assumed at 2/3.

Further refinements were not considered as essential until conditions of approach channel and general design of structure were further settled.

Weir heights were assumed at —3.0, 0.0 and +5.0, and discharge computed per lineal foot under 2d and 3d conditions named above.

With the —3.0 elevation having a width assumed of 15 feet, the two conditions were found to require a length of 13 feet at elevation 0, and 69 feet at elevation +50, a total length of weir of 97 feet.

The discharge of this weir was also computed under condition two for heights of approach 1, 2 and 3 feet lower, and similarly under condition 3.

The effect of variations in water elevation in the improved channel below the weir was not considered directly, but may be closely approximated from the plotted discharge curve here shown.

A discharge curve is also shown, similarly constructed, for the +5.0 weir prolonged 13 feet, giving a total weir length of 110 feet, to meet the fourth condition.

The vertical distance between these curves over any given discharge shows the amount of lowering of flood level due to this increased length, being about 0.9 feet for a discharge of 18,000 cubic feet per second, and about 0.5 feet for 8,000.

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For several reasons it is thought that this amount of lowering may not be undesirable.

A discharge of 18,000 cubic feet per second has been assumed for a maximum on weir instead of 17,000 as elsewhere mentioned. No attempt at measurement of the discharge of the separate streams has been made. This difference in discharge will make but 0.4 feet difference on height of weir, and can be readily regulated after trial. The above seems the safer assumption.

In general it is proposed to construct a fill along the city line sufficient to prevent overflow within the city, to construct a timber crib weir of the general heights above indicated, protected at ends by abutments, and the bottom below the weir protected by a timber apron, on piles, if the soil should require, or rip-rap filling extending down stream as far as the erosive effects of the overfall may seem to require.

CONCLUSIONS.

The quantity of discharge to be cared for is within 25,000 cubic feet per second, excepting in exceptional floods, as May 20, 1894, and March 1, 1902.

That even such discharge would not produce serious overflow if not complicated with other causes.

That the slope required is easily obtainable, and that when used is quite safe, on the basis on which the quantity of discharge is estimated.

That the effect of obstructions at the outlet, or of high level of discharge, will not be of importance along the upper courses of the streams.

That a separate outlet is a safeguard against a combination of events which might produce an undesirable height of flow.

That it is necessary to properly control the waters at their entry into the city.

That a combination of causes may produce an elevation of flood water which will produce a damaging overflow.

That the probability of the occurrence of such combination of causes is not sufficiently great to warrant further endeavors to prevent it.

The diagrams and computations here given were made as a study of a special problem. They have not been checked. They are not believed to contain errors sufficient to destroy their usefulness for the purpose intended.

(Signed.) GEORGE H. NORTON,
Assistant Engineer,
Bureau of Engineering.

(Signed.) C. M. MORSE,
Dep. Engineer Commissioner.

For

HON. ERASTUS C. KNIGHT,
CHARLES M. MORSE,
A. J. ELIAS,
F. WILLIAMS,
FRANCIS G. WARD,
GEORGE H. NORTON,
C. A. MCLAUGHLIN,

Local Committee.

C. M. MORSE,
Deputy Engineer Commissioner.

Buffalo, N. Y., February 6, 1903.

The following maps and diagrams, which accompanied the Buffalo report, will be found in Appendix No. 6, as follows:

Map of flooded territory in the city of Buffalo. Plate XV.

Map of the drainage areas of the Buffalo river, Cayuga and Cazenovia creeks in Erie and Wyoming counties. Plate XVI.

Profiles of flood lines along Buffalo river at various floods. Plate XVII.

Profiles of flood lines at four points on Cazenovia creek in the city of Buffalo. Plate XVIII.

Flood hydrographs for Buffalo river and Cazenovia creek for flood of March 1, 1902, at various points. Plate XIX.

Table of numerical elevations of flood heights in Buffalo river and Cazenovia creek for various floods at various stations in the city. Plate XX.

Curves of probable maximum discharge. Plate XXI.

Back-water curve for varying heights of water at lake outlet. Plate XXII.

Curves of discharge; also dimensions of proposed regulating weir at Buffalo city line. Plate XXIII.

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Oak Orchard Committee Report.

To Prof. Olin H. Landreth, Hon. D. C. Middleton, *Water Storage Commissioners, Western Division, of the State of New York:*

The undersigned, Local Water Storage Commissioners, appointed by you, would respectfully report as follows:

The Tonawanda-Oak Orchard swamp lies partly in the county of Orleans and partly in the county of Genesee, in this State. It consists of 25,000 acres of land, which are submerged during a considerable portion of the year, and there are 88,000 acres of land within the watershed. The outlet to this swamp is the Oak Orchard creek, which, after leaving the swamp, flows northward through the village of Medina and into Lake Ontario. The Tonawanda river or creek passes northwesterly from the village of Batavia, in the county of Genesee, until it approaches within three miles of the Oak Orchard creek, near the outlet of the swamp, and then it flows westerly into the Niagara river, at Tonawanda.

At the time of the construction of the Erie canal, and about the year 1822, the State of New York constructed a channel or feeder from the Tonawanda river at the point where it approaches nearest to the Oak Orchard creek, across to the said Oak Orchard creek, and by means of a dam in the said Tonawanda river, the waters thereof were diverted across and through the outlet of said swamp into the Oak Orchard creek, so as to increase the capacity of the same for feeding the Erie canal at Medina, N. Y., into which canal said waters are diverted from time to time as needed.

This was done in pursuance of a contract, in writing, with the landowners and owners of mill privileges on the Oak Orchard creek, that the said feeder should be maintained perpetually. The said diversion of waters, and feeder, have been maintained ever since their original construction. As originally planned by

Geddes, the engineer in charge, the said feeder from Tonawanda to Oak Orchard creek was to have been eighty feet in width. As constructed and now maintained, however, it is only thirty-eight feet at its widest part, and this is much narrowed in places by underbrush growing on the margins and by dirt which has fallen into it.

Not only by the diversion of the waters of said Tonawanda creek to the Oak Orchard creek was the volume of water in the Oak Orchard creek increased, but, by means of the banks of the said canal feeder, all of the intervening waters belonging to the Tonawanda creek watershed, including Whitney creek, which alone drains about 6,000 acres of land, were intercepted and diverted from their outlet into the Tonawanda creek over to the said Oak Orchard creek. (See map of Oak Orchard creek watershed, made by James T. Gardiner, Director, for the New York State survey, in 1883.)

The outlet of the said Tonawanda-Oak Orchard swamp, by means of the said Oak Orchard creek, is over and through a rocky ledge from the said outlet near Coon's bridge, to Shelby Center, a distance of about four miles. It is this ledge of rock which causes the swamp.

There is abundant outlet northward from Shelby Center, "where Oak Orchard creek falls off suddenly forty or fifty feet, and then descends rapidly to the north through the village of Medina." (See page 26 of Report of the New York State Survey, for the year 1883.) But there is a fall of only about eight feet from the said outlet of the swamp at Coon's bridge to Shelby Center, across said rocky ledge, and for considerable of the distance the water in said outlet is nearly on a level.

The diversion of the said waters of Tonawanda and Whitney creeks into the Oak Orchard creek increased the amount of waters to be discharged through the said Oak Orchard creek to more than the capacity of said creek, where it passes across said rocky ledge, and thereby resulted in greatly increasing the flooding of adjacent lands, especially in times of freshets and high water.

During the month of July, 1902, such an overflow resulted, by reason of the diversion of said waters of Tonawanda creek and Whitney creek, being thrown into those of Oak Orchard creek,

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by which a lake was created within the watershed of Oak Orchard creek, which covered more than 5,000 acres of land — much of them valuable farm lands containing growing crops — and which overflowed into the watershed of the Tonawanda creek, flooding an immense amount of lands there also and causing enormous amounts of damages.

The liability of the State for these damages, by reason of the diversion of said waters, is well established in law and has been recognized by the State throughout the history of said feeder, not only by allowance and payment of large claims for damages from time to time, but by appropriations by the Legislature and expenditure of money for the enlargement of the said channel of Oak Orchard creek across the said rocky ledge. But the said outlet has never been made sufficiently large to carry off the said diverted waters and the Tonawanda-Oak Orchard swamp waters, as the experience from the floods of 1902 abundantly proves.

Now on file in the county clerk's office of Genesee county will be found an award of damages by the Canal Appraisers of the State of New York to the town of Alabama, by reason of such overflow of waters and injuries therefrom, which award was recorded in said Genesee county clerk's office on the 24th day of October, 1849. In that report, which will doubtless be found on file in Albany, the said Canal Appraisers say: "When the feeder was built, it was so unskilfully constructed that the waters of the feeder overflowed its banks at points north of the above-mentioned road (Lewiston road), filling the adjacent swamp with waters of the Tonawanda creek in such quantities that in every spring and fall they flooded the swamp and it was converted into an active stream, passing southerly across these roads at different points with such force as to wash off the superimposed sand and gravel from the respective causeways, subjecting the town to great annual expenses to replace it." While some attempts have been made at improvement of the conditions described by said Canal Appraisers, practically the same condition exists to-day. The said award was made after a meeting of the said Canal Appraisers in said town of Alabama, Genesee county, and after a personal view of the lands in question, as well as the taking of evidence.

From time to time other awards have been made to the said town of Alabama, the last one being an award of $1,500, made by the Board of Claims about five years ago. The adjacent owners of lands injured by these overflows have, from time to time, made claims against the State for the damages caused, which have been allowed by the Court of Claims or appropriate tribunal at the time.

Claims are now pending, filed by the owners of adjacent lands, with the Court of Claims, by reason of the floods of 1902, which aggregate the sum of many thousands of dollars, the larger portion of which the State will be obliged to pay. (See claims now on file in the Court of Claims of the State.)

As a matter of law, the injury being a continuing one, the State will continue to be liable to the payment of these claims as long as present conditions remain and until relief is had from those conditions.

Many years ago an appropriation was made by the Legislature of the State for the purpose of enlarging the channel of said Oak Orchard creek across said rocky ledge, but the appropriation was entirely inadequate. By chapter 136 of Laws of 1893, another appropriation of $35,000 was made by the Legislature of the State for the purpose of further enlarging the said channel of Oak Orchard creek across said rocky ledge, and so assisting in carrying off the said waters; but still the appropriation was entirely inadequate. A channel was then cut through said rocky ledge from Coon's bridge, about three miles northward, which channel, however, is only sixteen feet in width and not sufficient to carry off the waters of said feeder alone, to say nothing of those coming from the Oak Orchard creek.

In order to carry off the waters coming from said Oak Orchard creek and said feeder, a channel across said rocky ledge, from the intersection of the said feeder with the Oak Orchard creek, to Shelby Center, at least forty feet in width and at least as deep as the present channel, as cut in the rock, should be constructed.

In our judgment, if such a channel is constructed, it will be sufficient to carry off said waters, thereby preventing floods, and will relieve the State from all liabilities for damages in the future.

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We file herewith, and refer to, a map and cross-sections of said outlet, made in pursuance to your instructions, by Joseph W. Holmes, civil engineer and surveyor, of Batavia, N. Y.

Dated January 22, 1903.

Respectfully submitted,

IRVING L'HOMMEDIEU,
FRED L. DOWNS,
JOSEPH W. HOLMES,
JOHN J. RYAN,
R. W. PORT,
Local Water Storage Commissioners.

(Received February 20.)

The two maps of Oak Orchard swamp and Oak Orchard swamp outlet will be found in Appendix No. 6, as Plates XXIV and XXV.

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APPENDIX No. 2.

Supplemental Matter from Second Division.

Flood damages at Oneida, N. Y., with photographs.

Lyons, N. Y., flood committee report.

Weedsport, N. Y., flood committee report.

Watkins, N. Y., flood committee report.

Potter, N. Y., flood committee report.

Binghamton, N. Y., flood damages, with photographs.

Syracuse report.

List of gauging stations.

Owasco Lake Storage.

Photographs of floods at Rome.

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Oneida Flood Damages.

Damages caused by floods of December 12, 1901 and March 1, 1902, in the city of Oneida, Madison county, N. Y.

Dallas Jones	$250 00
Thomas Kelley & Son	225 00
William Logan	400 00
Elizabeth Kilts	300 00
Chauncey L. Kinney	200 00
John X. Smith	500 00
Charles O'Heron	500 00
Charles Harding	500 00
Albert Johnson	300 00
William Hart	200 00
Morris Wilson	50 00
Bennett & Klock	300 00
Richard J. Roberts	400 00
Mrs. Georgianna Irving	300 00
William Ceigler	250 00
Mrs. Wescott	1,000 00
William White	250 00
Thomas Kennedy	1,000 00
Alice Burke	500 00
Martin Carroll	200 00
Hattie Tillottson	200 00
Nettie Dennison	200 00
Fred Z. White	128 00
Wescott Chuck Company	5,355 00
John Lambert	250 00
S. J. Wilson	300 00
George T. Hook	50 00
James A. Gregg	1,250 00

Burt Olney Canning Company	$20,000 00
W. E. Johnson	300 00
Mrs. Taft	250 00
	$36,303 00

FLOOD PHOTOGRAPHS AT ONEIDA.

The following photographs show some of the flood features at Oneida.

A map of the Oswego, Seneca and Oneida rivers will be found in Appendix No. 6, forming Plate XXVI, and a map of the city of Oneida forms Plate XXVII. A map and a profile of a portion of Oneida creek north of Durhamville form Plates XXVIII and XXIX.

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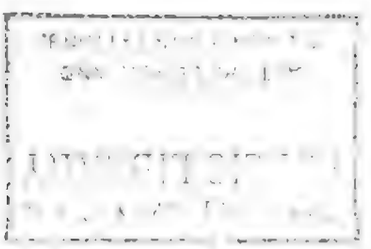
Downtown Amherst in Flooding, N. Y., December 19, 1985



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Front door of New York, Ontario and Western Railway, December 12, 1891.

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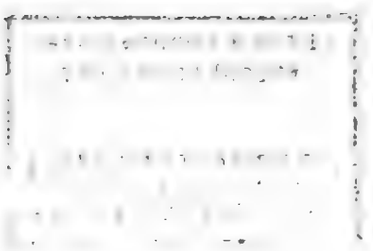
Photo Courtesy Tennessee Valley Authority



William G. Hopper by Bertha A. Hawley, courtesy of Society for Indian Philanthropy, Inc., 1941.

Lyons Flood Committee Report.

To the Water Storage Commission of the State of New York:

GENTLEMEN.— The undersigned, a committee appointed by the trustees of the village of Lyons, in company with your representative, George W. Rafter, visited several localities in this vicinity, on September 29, 1902, for the purpose of inquiring into the existence of flood conditions, and the possibility of their removal.

The topographic sketch map issued by the United States Geological Survey, and based upon data collected by them in 1899, shows very extensive flats of land in Eastern Wayne county that are almost entirely swamps, or are drowned out by inundations. These are not lowlands, in the ordinary sense, being almost uniformly at an elevation of very nearly one hundred and fifty feet above Lake Ontario. Their submergence either continuously, or at intervals, is due to the fact that the narrow ledge of limestone known as the Niagara formation, which is impervious to water, and does not weather down rapidly, extends east and west across the northern part of Wayne county at the elevation above Lake Ontario that has been named, forming a natural barrier, or dam, behind which there has been a gradual accumulation of soil forming the flats that have been mentioned, through which the streams are sluggish, and drainage difficult. From Lyons northeastward to Sodus bay there is such a flat covering an area of at least eight square miles, or upwards of five thousand acres, which is entirely swamp land. There are large areas also leading into this flat that are difficult to drain effectually. At present the ditches in this region extend southward into Clyde river, but have so little fall that they do not carry the water off at all during inundations which extend over considerable areas, and at other times the water in them moves so sluggishly that they are unable to clear themselves by the natural process of scouring,

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and soon fill up with sand and decayed vegetation. Thus the region is miasmatic, and has little value agriculturally, although the soil is excellent if drained. It would be an immense benefit if an outlet could be had northward, there being plenty of fall in that direction, provided that the Niagara formation of rock could be penetrated at some point favorably situated. This being done there would be no backing up of water during inundations, and no tendency of the channels formed to fill up. On the contrary any such channel once opened would tend to deepen itself by natural processes of erosion during every flood that might occur, instead of filling up as at present. Many years ago some attempt was made to drain these swamp lands northward with some beneficial effect, but the effort does not appear to have been directed by adequate engineering skill, at least there is no account of any attempt to attack the rock barrier which is the source of the whole difficulty. It would seem to be a problem worthy of note in connection with the work of your commission. It is estimated that during the past season the damage to crops on bottom lands, adjacent to these swamps amounted to at least one-fifth of their value over an area of several thousand areas, such losses being due to unusual inundations, and in addition to those occurring normally each season in this region. These special losses this year would perhaps amount to $5,000 for each square mile of the territory affected, which would foot up to a very large sum in the aggregate, there being a great many square miles of such bottom lands subject to drowning out through floods, in this part of eastern Wayne county, in addition to swamp lands, more or less constantly under water from the causes named, and which would seem to be removable.

The committee, in company with your representative, also visited the location of the railway bridges across Clyde river, below the village of Lyons, which bridges, when there is ice accumulation, form an obstruction dangerous to the structures themselves, and backing the water up into the lower part of the village. The new bridge on the main line of the New York Central has recently been reconstructed, and placed at a lower level,

and with tight sides, so that in case of ice accumulation above it there is considerable danger of damage occurring in the way mentioned, and it is thought to be a matter of sufficient importance to mention in this report to your commission.

All of which is respectfully submitted.

M. A. VEEDER,
H. G. HOTCHKISS,
JOHN L. COLE,
GEORGE W. BANKS,
WILLIAM S. SCOTT.
Committee.

LYONS, N. Y., *November* 26, 1902.

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Weedsport Flood Committee Report.

WEEDSPORT, N. Y., *November* 25, 1902.

Water Storage Commission, State of New York, Albany, N. Y.:

GENTLEMEN.— In accordance with your request, through Mr. Geo. W. Rafter, to Chas. S. Caywood, Esq., president of the village of Weedsport, N. Y., the floods in this section along the Seneca river have been investigated and the following facts found — the copies of the several letters appended giving the damage in the several instances.

WEEDSPORT, N. Y., *November* 24, 1902.

To whom it may concern:

This is to certify that I am interested in a farm of about 120 acres lying near the Seneca river. We have been damaged quite seriously, more or less, for a few years past and the trouble seems to be increasing, I think from the damming of the waters below us, by embankments at bridges and by the cut below being filled up. In the year just past, 1902, we had quite a large crop of sugar beets entirely destroyed, about eight or ten acres of corn and other crops on the river bottom. This damage makes much of this land nearly worthless that would be the most valuable farming land if the fault could be remedied. Our damage the past year would probably be $300.

Yours truly,

C. C. ADAMS.

WEEDSPORT, N. Y., *November* 24, 1902.

GENTLEMEN. — Regarding losses in recent years by damage from floods from Seneca river, would say I lost as follows:

In 1901 — 16 acres of hay, 14 acres of pasture, 5 acres of corn (very poor), 2 acres of beets (very poor), 4 acres of corn.

1902 — 10 acres of corn, 7 acres of cabbage, 14 acres of pasture, 8 acres of hay, 1 acre of carrots, ½ acre of beans.

The river is filling up and should be dredged at once.

Yours respectfully,

JOHN ROSA.

TOWN OF BRUTUS, CAYUGA COUNTY,
STATE OF NEW YORK.

GENTLEMEN.— In 1901 the high water from Seneca river caused the loss of forty (40) acres of meadow land, and twenty (20) acres of pasture, nine (9) acres of wheat drowned out and ten (10) acres of tillable land.

1902, the high water from Seneca river caused the loss of five (5) acres of meadow land, twenty (20) acres of pasture, five (5) acres of wheat, five (5) acres of sugar beets and thirty-five (35) acres of corn, and it is continually getting worse. Land that we used to get good crops off from twenty years ago is worthless but we're taxed on it just the same.

JAMES A. CLEMENTS.
Jordan, N. Y.

P. O. Box 414.

WEEDSPORT, N. Y., *November* 24, 1902.

GENTLEMEN.— Twelve acres of corn, 5 acres of cabbage, 4 acres of beets, 4 acres of barley. This is my loss in 1902. In 1901 the use of 50 acres on which I have paid taxes for thirty-five years was all destroyed by high water and will and has raised the largest crops of hay, corn, beets, barley, oats and wheat and is now becoming worthless.

DAVID FOLLETT.

WEEDSPORT, N. Y., *November*, 1902.

GENTLEMEN.— Two acres of sugar beets, 4 acres of cabbage, 3 acres of corn, 6 acres of hungarian, 4 acres of pasturage, ¼ of an acre of carrotts. This is our loss in 1902 and nearly the same in 1901. In fact there isn't a year that we have high water in the

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spring but some parts has to go unworked. The water not going off time enough to do anything with it.

Yours respectfully,

JACOB ROSA.

WEEDSPORT, N. Y.

GENTLEMEN.— My loss in 1901 — 4 acres of corn, 4 acres of timothy meadow, 10 acres of pasture part of the time.

In 1902 — 4 acres sugar beets, 4 acres hungarian hay, 4 acres of corn, 10 acres of pasture most of the time.

Yours truly,

C. E. JEWELL.

WEEDSPORT, N. Y.

GENTLEMEN.— Nine acres of corn, 2 acres of hungarian, 1 acre of beets, 5 acres of pasture, in 1902.

In 1901, did not have anything on the island on account of the water being so high and staying high so long.

JAMES D. SUITS.

WEEDSPORT, N. Y.

GENTLEMEN.— Seven acres of corn, 7 acres of oats, 2 acres of tomatoes, 2 acres of buckwheat, 1 acre of potatoes, 1 acre of wheat. This is my loss in 1902.

In 1901, the use of 20 acres, on which I paid taxes for 25 years, was all destroyed by high water, and which is all good land and will and has raised good crops, and now has become useless.

SEYMOUR STURGIS.

WEEDSPORT, N. Y.

GENTLEMEN.— Our property which is located on what is known as Hickory island in Seneca river, 35 acres of which has been damaged to such an extent that in 1901 it was impossible to harvest anything and but little pasture. In 1902 we have re-

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moved nothing in the line of crops. The overflowing killing out 10 acres of meadow and nearly destroying the 6 acres of pasture. The remaining 19 acres, which was used for gardening and the growing of roots, was entirely useless. The 2 years preceding 1901 and 1902 the crops were damaged more or less by water overflowing the lands.

G. GUY WHITMAN.

The loss sustained by John A. Traver for the season of 1902 by waters of Seneca river was: corn, 12 acres; cabbage, 10 acres; tomatoes, 3 acres; oats, 5 acres; sugar beets, 2 acres; potatoes, ½ acre; garden, ½ acre; pasture, 10 acres.

The above is for 1902. In 1901 the acreage was about the same although the crops were different. The loss was total.

WEEDSPORT, N. Y., *November* 25, 1902.

To whom it may concern:

Although I own no land that has been damaged by the high water of Seneca river, I have lived near the stream for thirty years, and have made a careful investigation in behalf of the farmers whose land is damaged by the high water, on several different occasions, and have found the following to be the facts in regard to the overflow.

First.— The condition of the land along the river is getting steadily worse. This fact is proven by observation and by the fact that lands which produced large crops of winter wheat a few years ago (for instance, one piece of land which produced 57 bushels per acre about 1880 or 1882, and produced large crops every year at that time, has lost every crop of wheat tried on it for 10 years back) will produce none now.

Second.— That this loss is not confined to a few acres or farms, as the State survey, made a number of years ago, shows that nearly 40,000 acres are damaged or made worthless.

Third.— That the cause of the damage is largely the filling up of the stream at certain points, one of which is Jack's Reefs, near Cross lake. I find that a number of years ago a coffer dam

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was built at that point with the object of removing a bar in the river. The bar was not removed, neither was the coffer dam. The silt from up the stream is settling at this point and filling the channel. The State ditch at this point (which is a cut across a neck of land) is also filling up. This, of course, holds back the water until late in the season.

In fact, the water has not been down to the so-called low water mark this season, and only for a short time last year.

W. A. TRAVER,

Architect, Weedsport, N. Y.

Watkins Flood Committee Report.

A communication was received from your honorable body by the president of the village of Watkins, asking for suggestions as to needed improvements for the better protection from floods in this locality.

A meeting was accordingly called and a committee appointed to make a report upon the same. The committee therefore begs to offer the following statement of facts: All of the drainage from this locality is discharged into Seneca lake. Seneca lake is a body of water 36 miles long and an average width of about 2½ miles. At the head or south end, it is about one mile in width, and its valley extends farther south for a distance of about 16 miles. From the lake south for about three miles, the valley maintains a width of about one mile and is comparatively level, a large portion being perfectly flat, and is known as Catharine Marsh. Three miles from the lake, the valley narrows rapidly, and ascends to an altitude of about 400 feet above Seneca lake.

The village of Watkins is situated at the southwest corner of the lake, lying principally upon the flat land and partially upon a hill at the side of the valley and contains a population of about 3,500.

The village of Montour Falls lies across the valley, three miles from the lake at a slight elevation above the lake at the point where the valley narrows and begins to rise. This village has a population of about 2,000.

Catharine creek originates at the head of this valley, draining a watershed of about 125 square miles of very steep, hilly country, cut up by ravines which in time of flood, discharge their waters into Catharine creek, each one constituting a mountain torrent, and causing the principal stream to rise very suddenly, rushing down its descent of 400 feet, and reaching lake level or nearly lake level at Montour Falls, three miles before emptying

into the lake, spreads out over the flat lands and backs up over the village of Montour Falls frequently inundating a large portion of the village, filling cellars and causing great damage and annoyance to its inhabitants. It also spreads out over the flat lands, intervening between the village and the lake, inundating several hundred acres of unusually valuable farming land. The course of this stream is along the east half of the valley from Montour Falls to the lake and is extremely crooked traveling a distance of five or six miles to get three miles.

Watkins Glen creek rises about 10 miles southwest of Watkins and drains about 50 square miles of country also very hilly and steep. This stream falls about 600 feet in its course, ploughing down through the narrow defiles of the Glen, reaches the valley at its west side about one mile from the lake and at an elevation of about 30 feet above the lake.

In 1848, the State constructed the Chemung canal from Seneca lake south, directly through the center of the valley, leaving Catharine creek to flow in its accustomed channel east of the canal and entirely separated therefrom, but dividing Watkins Glen creek and giving it a new and independent channel to the lake, west of the canal. There were several small streams which emptied into the canal and reached the lake by that course. Watkins Glen creek was conducted as mentioned above to the lake by a new and independent channel, which while leaving two very abrupt angles, caused no serious damage. This left three means by which the water from this watershed reached Seneca lake, to wit: Catharine creek, Watkins Glen creek and the Chemung canal.

About 1893, the canal department again diverted Glen creek from its independent channel, and turned it into the canal. The stream now rushes down at a speed of 10 or 15 miles per hour with a depth, frequently of 6 or 7 feet and a width of 50 feet, and enters the canal at an angle of about 45 degrees at lake level, but 300 or 400 yards from the lake at this point it has deposited several thousand yards of gravel in the canal at the side of the creek, most remote from the lake which has completely filled the canal at least a foot above the level of the water, thereby preventing a single gallon of water from coming down the canal, the

results of which has been in every flood to fill the canal up from one to two feet higher than it otherwise would fill, resulting in the inundation of much valuable land and the destruction of many thousand dollars worth of crops.

If Watkins Glen creek were again given an independent channel to the lake and the above mentioned bar removed from the canal, the water which is tributary to the canal could flow directly to the lake and these floods be avoided. If in addition to this, the course of Catharine creek were straightened, the losses from floods would be reduced to a minimum. Disastrous floods have occurred, of which the following exact dates are available.

August 1, 1889; June 16, 1896; December 14, 1901; July 5, 1902; July 24, 1902; April 17, 1896; November 21, 1900; February 28, 1902; July 19, 1902.

Several other floods have occurred before these dates, and since the date of the first one given above, but as the exact dates are not available, they can only be mentioned in a general way. Floods are not confined to any particular season, but owing to the rugged contour of this section, any violent rainfall is liable to cause severe damage unless the channel to the lake is direct and unobstructed.

C. W. INGALLS,
Chairman.

Potter Report.

POTTER, N. Y., *November* 20, 1902.

Water Storage Commission, Albany, N. Y.:

DEAR SIR.—We are a few of the many interested parties of the flooded district in the town of Potter, Yates county, and the town of Gorham, Ontario county, who desire to present to you for your inspection the conditions as they are and respectfully ask you to come and see the same and see if we can not have relief. The flooded district is located on Fluck and Nettle Valley creeks. Amount of land flooded, about 8,000 acres; a portion of it rendered nearly worthless, the balance of it is uncertain of any crop at all.

The course of these streams are so crooked and shallow there is no chance for water to get off from the land. The streams overflow all the flats at any season of the year when a hard rain occurs, also destroying roads and bridges, making the damage very great to all parties.

If a ditch of proper width and depth was put through this district about 8 or 9 miles long it would enable the many owners to ditch the land and would make it as good land as there is and very valuable. Let us hear from you. Could furnish pictures if desired of large number of farms.

Respectfully yours,

M. A. LOUNSBERRY,
CHAS. E. WELLS,
GEORGE HALSTEAD,
JOHN SMITH.

Binghamton Flood Damages.

BINGHAMTON, *July* 1, 1902.

NUMBER OF RESIDENCES AND STORES, FACTORIES AND CHURCHES DAMAGED BY HIGH WATER ON MARCH 1 TO 5, 1902, IN THE FIRST WARD, CITY OF BINGHAMTON.

Oak Street.

Basements	34
First floor	12
Total	46

Gaines Street.

Basements	3
First floor	6
Total	9

Front Street.

Basements	74
First floor	10
Total	84

Valley Street.

Basements	2

Franklin Street.

Basements	9
First floor	1
Total	10

Prospect Street.

Basements	1

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Elm Street.

Basements	5
First floor	25
Total	30

Winding Way.

Basements	13
First floor	24
Total	37

Dickinson Street.

Basements	20
First floor	19
Total	39

McDonald Avenue.

Basements	9

Murray Street.

Basements	20
First floor	14
Total	34

Lydia Street.

Basements	36
First floor	12
Total	48

Meadow Street.

Basements	6
First floor	9
Total	15

Mygatt Street.

Basements	12
First floor	12
Total	24

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Spring Forest Avenue.

Basements	7
First floor	16
Total	23

Spruce Street.

Basement	1
First floor	5
Total	6

Everett Street.

Basements	10
First floor	4
Total	14

Halford Street.

First floor, Happy Bros	2

Star Avenue.

Basements	2

Wolcott Street.

Basement	1
First floor	5
Total	6

Whole number of buildings damaged was 440; of which 176 of the above the water was over the first floor. Among the above are 3 factories, 7 stores, 1 market, 2 churches and 1 greenhouse.

264 houses with water in cellars nearly to first floor, estimated damage $30.00 each	$7,920 00
176 houses with water over first floor, estimated damage to each $50.00, whole amount	8,800 00
	$16,720 00

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ASSESSED VALUATION OF PROPERTY IN FLOODED DISTRICT OF FIRST WARD 1901 AND 1902.

Front Street—West.

	1901.	1902.
Stanbrough, L. D.	$4,000 00	$3,800 00
Stanbrough, L. D.	4,000 00	3,800 00
Hills, L. H.	4,000 00	3,700 00
Babcock, H. C.	4,000 00	3,700 00
Campbell, Mrs. A. T.	4,000 00	3,700 00
Campbell, Mrs. A. T.	4,000 00	3,700 00
Childs, Mrs. M. W.	4,000 00	3,700 00
Childs, Mrs. M. W.	4,000 00	3,700 00
Walters, J. W.	4,300 00	4,000 00
Beecher, H. M.	4,000 00	3,600 00
McTighe, M.	3,800 00	3,600 00
Edmister, W. D.	1,800 00	1,600 00
Griswold, L. M.	1,800 00	1,600 00
Robinson, Mary E.	2,000 00	1,700 00
Cunningham, P. W.	1,800 00	1,600 00
McDonald, W. A., Executor.	1,800 00	1,600 00
Burget, Mary E.	1,800 00	1,600 00
Burget, Mary E.	1,800 00	1,600 00
Quilligan, James	1,400 00	1,200 00
Wheeler, Anna M., Guardian.	2,500 00	2,300 00
Wheeler, Anna M., Guardian.	2,400 00	2,200 00
Lynch, Mrs. J. R.	2,400 00	2,200 00
Christie, Walter	3,000 00	2,700 00
Cutler, John W.	2,500 00	2,300 00
Sparks, E., et al.	2,500 00	2,300 00
Merchant, T. B. & L. M.	2,200 00	2,000 00
Merchant, T. B. & L. M.	2,200 00	2,000 00
Morall, J. E., Pen. Ex., 1,600.	1,600 00	1,600 00
Lewis, Geo. N.	3,000 00	2,800 00
Jackson, Maria W.	1,500 00	1,300 00
Coon, Geo.	1,000 00	900 00
Beach, Geo. S.	3,400 00	3,100 00
Hazley, James	1,500 00	1,200 00

	1901.	1902.
Hazley, James	$1,000 00	$900 00
Bauman, F. J.	1,500 00	1,125 00
DeRoche, Louis	1,800 00	1,500 00
Murray, William	900 00	700 00
Murray, William	900 00	700 00
Mills, Sarah S.	700 00	600 00
	$96,800 00	$87,925 00

Front Street — East.

	1901.	1902.
Keough & Cary, Executors	$6,600 00	$6,400 00
O'Neil, Matthew	4,000 00	3,800 00
O'Neil, Simon	4,000 00	3,800 00
Hotchkiss, Albert	2,200 00	2,000 00
Magrath, P. F.	2,200 00	2,000 00
Case, Chas. S.	2,300 00	2,100 00
Morse, Ellis W.	2,200 00	2,000 00
Magrath, P. F.	2,300 00	2,100 00
Jones, D. D.	2,500 00	2,300 00
Webster, W. B.	2,100 00	1,900 00
Seymour, Harriet	2,700 00	2,400 00
Folsom, Emma L.	1,600 00	1,500 00
Truesdell, E. S.	1,500 00	1,300 00
Magrath, R. B.	1,500 00	1,300 00
Knapp, E. A.	1,500 00	1,300 00
O'Connor, John M.	1,500 00	1,300 00
Griswold, E. A.	1,600 00	1,500 00
Bartoo, E. H., et al.	1,500 00	1,300 00
VanDeBogart, H. V.	3,400 00	3,100 00
Franchois, J. L.	1,600 00	1,400 00
Truax, Homer	1,700 00	1,500 00
LaPoint, Zoa	1,400 00	1,200 00
Harding, Anna	1,800 00	1,600 00
Bradley, Sarah C.	800 00	700 00
Bradley, Sarah C.	800 00	700 00

	1901.	1902.
O'Donnell, Albion	$1,400 00	$1,200 00
Star Electric Co., Addition	3,000 00	3,000 00
Dickinson, John N., Pen. Ex	1,200 00	1,200 00
Truax, Homer	1,300 00	1,200 00
Gregory, Chas. B.	1,200 00	1,100 00
Beyea & Kipp.	1,000 00	900 00
Caldwell & Rhodes	800 00	700 00
Caldwell, N. J.	900 00	800 00
Caldwell, N. J.	500 00	450 00
English, Jeremiah	600 00	500 00
Drake, J. B.	500 00	450 00
	$67,700 00	$62,000 00
Front street, west	96,800 00	87,925 00
Total	$164,500 00	$149,925 00

McDonald Avenue.

	1901.	1902.
Campbell, Frank B.	$900 00	$800 00
Heath, Robert S.	1,300 00	1,200 00
Hogan, Edward	2,500 00	2,400 00
Harris, M. E.	2,800 00	2,600 00
	$7,500 00	$7,000 00

Winding Way—West.

	1901.	1902.
Terry, Geo. D.	$1,600 00	$1,500 00
Stone, Lucy	1,600 00	1,500 00
Babcock, Augustus, Executor	2,500 00	2,300 00
Willey, A. L.	2,800 00	2,500 00
Sullivan, J. D.	2,000 00	1,900 00
Sullivan, J. D.	1,800 00	1,600 00
Holmes, J. N.	2,500 00	2,300 00
Jayne, Jessie A.	1,600 00	1,400 00

	1901.	1902.
McGivney, Mary	$1,800 00	$1,600 00
Bossom, K. M.	1,000 00	900 00
Bossom, K. M.	1,000 00	900 00
Bossom, K. M.	1,600 00	1,500 00
Kennedy, Wm., et al	1,100 00	1,000 00
	$22,900 00	$20,800 00

Winding Way — East.

	1901.	1902.
Cross, Geo. N.	$1,000 00	$900 00
Bishop, Fred E.	1,000 00	900 00
Hermans, H. C.	1,000 00	900 00
Black, Phoebe	1,000 00	900 00
Chaplin, G. A.	1,000 00	900 00
Chaplin, G. A.	1,000 00	900 00
Gardner, Mary N.	1,000 00	900 00
Hull, John, Jr.	1,000 00	900 00
Upson, Mary A.	1,000 00	900 00
Rogers, Louise G.	3,500 00	3,300 00
Hotchkin, C. A., et al	1,600 00	1,500 00
Wheeler, A., Guardian	1,300 00	1,200 00
Morse, Hartwell, Executor	1,300 00	1,200 00
Sexton, Mary S.	800 00	700 00
Truman, E.	1,000 00	900 00
Matthews, F. H. & C. D.	1,600 00	1,500 00
Matthews, F. H. & C. D.	1,300 00	1,200 00
Rockwell, D. H.	1,300 00	1,200 00
Rockwell, A. D.	1,300 00	1,200 00
Reynolds, Geo.	1,600 00	1,500 00
Bristol, W. H.	1,600 00	1,500 00
	$27,200 00	$25,100 00
Winding way, west	22,900 00	20,800 00
	$50,100 00	$45,900 00

Oak Street—West.

	1901.	1902.
Sullivan, Mary	$1,000 00	$900 00
Mangan, Martin	1,500 00	1,400 00
Kelly, James, F., improved	1,600 00	1,600 00
O'Neil, Geo. F.	1,000 00	900 00
O'Neil, Geo. F., in rear	300 00	250 00
McMahon, Margaret	1,600 00	1,400 00
West & Hardt	1,600 00	1,400 00
Byrnes; Michael	1,800 00	1,700 00
White, Margaret	1,400 00	1,300 00
Edson, Eunice B.	1,500 00	1,300 00
Hulbert, F. B.	150 00	100 00
Mead, N. Frank	500 00	400 00
Sellick, D. P.	600 00	500 00
Burns, E. J.	700 00	600 00
Cary, Matt. C.	400 00	300 00
	$15,650 00	$14,050 00

Oak Street—East.

	1901.	1902.
Henwood, J. M., Executor	$1,200 00	$1,100 00
Chiddester, A. J., Pen. Ex	1,200 00	1,200 00
Pierce, Geo. A.	2,000 00	1,800 00
Pierce, Geo. A., improved	1,300 00	1,300 00
Pierce, Sarah E.	1,300 00	1,200 00
White, Mary	1,100 00	1,000 00
Fowler, Jennis S., improved	1,000 00	1,000 00
Wightman, H. A.	1,100 00	1,000 00
Cotton, Rose L.	1,700 00	1,500 00
Kennedy, Wm., et al	2,000 00	1,800 00
Newing, Hattie	1,100 00	1,000 00
Eaton, Julia W.	1,200 00	1,000 00
Phelps, W. G., Guardian, 2 pieces	2,300 00	1,900 00
Clark, Grace	2,000 00	1,800 00
	$20,500 00	$18,600 00
Oak street, west	15,650 00	14,050 00
Total	$36,150 00	$32,650 00

Murray Street.

	1901.	1902
Flanigan, A.	$1,500 00	$1,400 00
Flanigan, A.	1,700 00	1,600 00
Graney, Michael	900 00	800 00
Graney, Michael	800 00	700 00
Boland, Susan	300 00	250 00
McKrell, John & Lavina	1,200 00	1,100 00
Boland, Catherine	1,300 00	1,150 00
Waldhoff, Louise	1,200 00	1,000 00
Snook, N. J.	1,100 00	1,000 00
Carman, A. B.	1,500 00	1,400 00
Carman, A. B.	1,500 00	1,400 00
Murphy, John J.	1,300 00	1,200 00
Yingling, Fred S.	1,400 00	1,300 00
Storton, John	1,000 00	900 00
Storton, Honora	700 00	650 00
Purtell, Nora A.	1,100 00	1,000 00
Gahagan, L. M. & L. L.	1,100 00	1,000 00
DeVanney, Catherine	1,100 00	1,000 00
Osincup, Wesley	1,000 00	900 00
Smith & Morgan	1,000 00	900 00
Converse, G. O.	1,100 00	1,000 00
	$23,800 00	$21,650 00

Dickinson Street.

	1901.	1902.
Farley, Belle	$2,400 00	$2,100 00
Green, Dela B.	1,000 00	900 00
Walker, H. R.	1,100 00	1,000 00
Howard, Darwin	1,600 00	1,500 00
Bishop, J. H.	1,400 00	1,300 00
Bishop, J. H.	1,400 00	1,300 00
Farley, Julia	900 00	800 00
Marvin, C. E. & E. J.	500 00	450 00
Farley, Belle	600 00	500 00

	1901.	1902.
Farley, Belle	$500 00	$450 00
Farley, Belle	500 00	450 00
Cudmore, M.	500 00	450 00
Cooney, John	900 00	800 00
Bennett, E. O.	600 00	500 00
Farley, William	700 00	500 00
Costello, Patrick	700 00	600 00
Murray, Patrick	900 00	800 00
Harris, E. L.	900 00	800 00
	$17,100 00	$15,000 00

Meadow Street.

	1901.	1902.
Kane, Mary	$600 00	$500 00
Maher, Mary	800 00	700 00
O'Donnell, Mary	800 00	700 00
Collins, Josephine	800 00	700 00
Houlihan, Patrick E.	900 00	800 00
Doran, Thos.	1,000 00	900 00
Briggs, L. B.	500 00	450 00
Foley, Patrick J.	700 00	600 00
Quain, John M.	700 00	600 00
Foley, Bridget	700 00	600 00
Davenport, F. R.	500 00	450 00
Camp, Dianna	800 00	700 00
	$8,800 00	$7,700 00

Lydia Stret.

	1901.	1902.
Newing, E. A.	$1,000 00	$900 00
Gotrean, Chas.	1,500 00	1,400 00
Gotrean, Chas.	1,100 00	900 00
Coyle, John	1,000 00	900 00
Newman, Frederica	900 00	800 00

	1901.	1902.
Mead, Lillian A.	$1,000 00	$900 00
Beals, Ellen L.	1,400 00	1,300 00
Wells, Mrs. B. W.	1,300 00	1,200 00
Horton, H. L.	1,100 00	1,000 00
McManus, Nora	1,100 00	1,000 00
Slater, Frank F.	1,100 00	1,000 00
Murphy, M.	300 00	250 00
Thompson, Amy	1,500 00	1,400 00
Heims, Louis H. & W.	1,600 00	1,500 00
Wells, Seth H.	800 00	700 00
Harris, Henry D.	1,600 00	1,500 00
O'Neil, Ellen	1,500 00	1,400 00
O'Neil, Ellen	1,500 00	1,400 00
Sands, R. M.	1,200 00	1,000 00
Woodruff, S. A.	1,200 00	1,100 00
Jenkins, Thomas	600 00	550 00
Hayes, John	1,000 00	900 00
Runyon, J. L.	900 00	800 00
Cage, Albert E.	1,100 00	1,000 00
Slauson, C. M.	300 00	250 00
Olds, Geo. H.	1,200 00	1,100 00
Lyon, M. W.	1,000 00	900 00
Olds, M. E.	800 00	750 00
Belles, Chas. E.	1,300 00	1,200 00
Hoyt, C. J.	1,400 00	1,300 00
Jackson, Mary	1,000 00	900 00
Jackson, Mary	1,000 00	900 00
Jackson, Mary	1,000 00	900 00
Mosher, A. H.	1,000 00	900 00
Duroche, H.	1,400 00	1,300 00
Willey, A. L.	900 00	800 00
Slauson, C. M.	1,200 00	1,100 00
Slauson, C. M.	1,100 00	1,000 00
Rogers, J. E.	1,100 00	1,000 00
	$43,000 00	$39,200 00

Elm Street — South.

	1901.	1902.
Carroll, T. E.	$700 00	$600 00
Lonegran, E., executor	450 00	400 00
Coon, Silas E.	500 00	450 00
Perault, Paul	500 00	450 00
Benn, Edwin	550 00	500 00
Jacobs, T. B.	600 00	500 00
Earl, Anna V. A.	500 00	400 00
Earl, Anna V. A.	500 00	400 00
Frazier, Hannah	500 00	400 00
Earl, A. V. A.	500 00	400 00
Earl, A. V. A.	500 00	400 00
Boyce, F. W.	500 00	400 00
Broat, Jerry C.	500 00	400 00
Broat, Laura A.	500 00	450 00
Harsh, W. E.	550 00	450 00
Galloway, Geo. W.	400 00	350 00
Osborn, E., 2 pieces	900 00	800 00
	$9,150 00	$7,700 00

Elm Street — North.

	1901.	1902.
Harold, Thos., 2 pieces	$1,100 00	$950 00
Cary, Cornelius	1,150 00	1,000 00
Labadie, Lucy	900 00	750 00
Cooney, Martin J., 2 pieces	650 00	500 00
Lewis, Julia A.	500 00	400 00
Smith, Howard L.	600 00	500 00
Toohey, Ann	500 00	450 00
Rogers, J. E.	850 00	650 00
Tully, J. B.	900 00	800 00
	$7,150 00	$6,000 00
Elm street, south	9,150 00	7,700 00
Total	$16,300 00	$13,700 00

Spring Forest Avenue — South.

	1901.	1902.
King, W. L.	$700 00	$650 00
Rittenburg, Emma	700 00	600 00
Kneeland, H. J.	600 00	500 00
Worden, B. R., 2 pieces	1,450 00	1,150 00
Griggs, Minnie C.	900 00	700 00
Romine, L.	700 00	600 00
Callahan, M. H.	900 00	800 00
Tully, James B.	2,000 00	1,700 00
Tully, James B.	1,000 00	800 00
Tully, James B.	1,000 00	800 00
	$9,950 00	$8,300 00

Mygatt Street.

	1901.	1902.
Osgood, L. A.	$1,600 00	$1,400 00
Vill, Bridget	1,300 00	1,200 00
Everett, H. C. & N. J.	1,100 00	1,000 00
Duffy, Edward	1,100 00	1,000 00
Klopsh, C. M.	1,000 00	900 00
Burke, M. M.	1,200 00	1,100 00
Sweet, E. H.	900 00	800 00
Flynn, Edward	1,000 00	900 00
Bennett, Mrs. L. J.	900 00	800 00
Gorman, Matthew	1,300 00	1,200 00
Carlin, Kate	1,100 00	1,000 00
Farrell, Owen, 3 pieces	1,900 00	1,700 00
O'Connor, Margaret	800 00	700 00
Kane, D. F.	900 00	800 00
Drake, J. B.	900 00	800 00
Lawler, J. J.	300 00	250 00
Lawler, John	1,000 00	900 00
Tully, James B.	2,200 00	2,000 00
Pender, Patrick	1,200 00	1,000 00
	$21,700	$19,450 00

Wolcott Street.

	1901.	1902
Hand, Patrick	$450 00	$400 00
Daughton, M.	400 00	300 00
Kratky, L.	300 00	250 00
Kocick, Stephen	300 00	250 00
Conant, Nettie E.	150 00	100 00
	$1,600 00	$1,300 00

Valley Street.

	1901.	1902.
Jones, J. C.	$600 00	$500 00
Turner, E. A. & F. J.	800 00	700 00
	$1,400 00	$1,200 00

Spruce Street.

	1901.	1902.
Bronosky, W. & Eliza	$400 00	$350 00
Ensign Lumber Company	600 00	500 00
Binghamton Railroad	200 00	150 00
Labadie, Lucy	800 00	600 00
Bishop, Fred E.	700 00	600 00
	$2,700 00	$2,200 00

Everett Street.

	1901.	1902.
Osgood, H. B.	$1,300 00	$1,200 00
Osgood, H. B.	600 00	500 00
McAuliffe, M. & P.	900 00	800 00
Gorman, Mary	1,000 00	900 00
Sanders, R.	800 00	700 00
Jackson, Wm.	1,000 00	900 00
Hoerrner, Charlotte	900 00	800 00
Sweet, J. M.	800 00	700 00
Fountain, Mary A.	900 00	800 00

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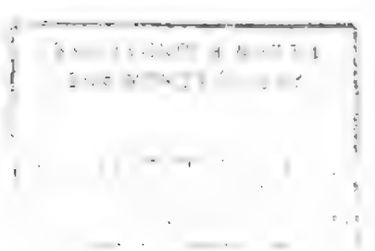

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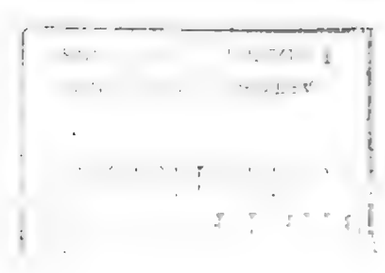

	1901.	1902.
Lipscomb, Wm.	$750 00	$700 00
McAuliffe, Michael	1,000 00	900 00
Frost, C. A.	1,000 00	900 00
Taylor, T. J.	1,000 00	900 00
Wallace, John	1,000 00	900 00
Banks, Geo. H.	1,000 00	900 00
	$14,050 00	$12,500 00

Gaines Street.

	1901.	1902.
Swan, E. R.	$1,200 00	$1,000 00
Johnson, J. E.	1,200 00	1,000 00
Whalen, M. & Anna S.	1,200 00	1,000 00
Phelps, W. G., Guardian	1,500 00	1,200 00
Phelps, W. G., Guardian	1,500 00	1,200 00
Clark, Grace	1,100 00	1,000 00
Clark, Grace	1,000 00	900 00
Clark, Grace	1,000 00	900 00
	$9,700 00	$8,200 00

Franklin Street.

	1901.	1902.
Deroche, J. L. & Wm.	$900 00	$700 00
Baumann, F. J.	300 00	225 00
	$1,200 00	$925 00
Total amount of foregoing list. .	$454,350 00	$409,550 00

Respectfully yours,

A. B. CARMAN,

Member of Committee.

A map of the city of Binghamton showing flooded districts will be found on Plate XXX.

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Syracuse Report.

The Water Storage Commission of the State of New York, Albany, N. Y.:

GENTLEMEN.— I beg to submit to you herewith a brief report or rather statement of the observations of those who were associated with me in accompanying your honorable body on the 12th day of May, 1902, down Onondaga lake and Seneca river to the Phoenix dam, and also the observations made by myself in company of part of your honorable body on September the first last down Seneca river to the Phoenix dam.

In December, 1901, and February, 1902, the city of Syracuse and vicinity were visited with disastrous floods, a large portion of the entire city was inundated, hundreds of houses were flooded, some above the first story while many others sustained severe damage to their cellars and first floors. Upon these occasions much land around Onondaga lake and Seneca river in Onondaga county were inundated that seldom if ever overflowed before.

For a few years prior hereto there has been more or less trouble in Onondaga county around the shores of the lake and along Seneca river at the outlet of the lake to a much greater extent than in previous years so that the people of Onondaga county, outside of these two great floods, have suffered a great deal of damage by high water which they invariably attributed to the dam across Seneca river at Phoenix.

On the above date your honorable body came to Syracuse and was joined by myself with a committee of citizens and proceeded down the lake in a boat and down Seneca river to the Phoenix dam for the purpose of making observations and ascertaining what, if anything, could be done to remedy this evil. I was requested by the members of that committee to call your attention to the following.

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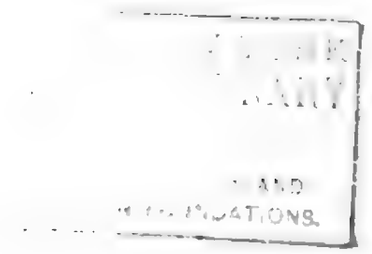

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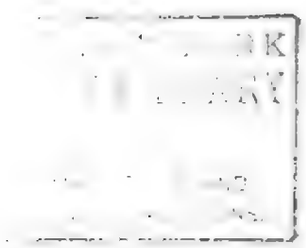

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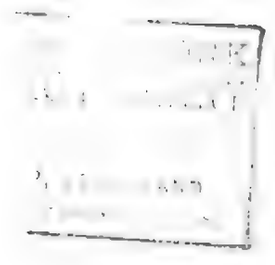

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First.— The outlet, as was observed, it is claimed has become narrowed and filled with dirt, etc., to such an extent that it impedes the flow of the water into the Seneca river and it is urged that this outlet should be dredged and widened.

It is also contended that the outlet should be changed in such a manner that it will not flow into the river at right angles, and that much difficulty could be obviated if the outlet could be turned so as to permit the flow of water down the river.

It is also contended that the outlet has caused a bar in Seneca river which should be removed, and that at this point a bridge once spanned the river and that there are large obstructions in the way of abutments or formations which supported the bridge, which impede the flow of the river and which should be removed.

Furthermore, it is contended that at Gaskin rifts, between this outlet and the Phoenix dam, the channel once made by blasting rocks for the purpose of deepening the water for canal boats to pass should be widened and that by the removal of these rocks and widening and deepening the channel there, it would facilitate the flow of water and relieve the waters above.

It is also contended that the Phoenix dam is a great obstruction and that the flush boards that were placed thereon in the summer time also serve as obstructions and tend to back up and conjest the water in such a manner that it obstructs the natural flow of the stream.

The fall from the outlet of the lake to Phoenix is so slight that the velocity of the water is greatly reduced by the dam.

It is claimed by this committee that the State has made improvements at Montezuma and Jacks Rifts in this county which has caused a much larger volume of water to flow and that the State is responsible for the increased flow from this cause, and that this committee therefore recommend to your honorable body,

That the outlet of Onondaga lake should be widened and deepened and the course of it changed into the river.

The bar in the river just below the dam should be removed, the old piers and other obstructions should be removed.

The river at Gaskin rifts should be widened and deepened and should provide for a passage of overflowed water at Phoenix

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dam, either by putting in flood gates and removing the flush boards, or by making a wide channel around the dam on the west side of the river, through which, in time, the high water surplus would flow freely.

It seems to them that this should relieve the situation.

Very respectfully submitted,

JAY B. KLINE.

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Gauging Stations.

ROCHESTER, N. Y., *May* 24, 1902.

MR. HARRY BATES, *Secretary of Water Storage Commission, State Capitol, Albany, New York:*

MY DEAR MR. BATES.—Your letter of May 23, in reference to meeting of the Commission on Thursday, May 29, instead of Wednesday, at hand. At this date, I am unable to say whether I shall be able to attend the meeting on either Wednesday or Thursday, so that so far as I now know the change does not inconvenience me in any way.

P. S.—Letter regarding gaugings herewith inclosed.

Very sincerely yours,

GEO. W. RAFTER.

ROCHESTER, N. Y., *May* 24, 1902.

MR. HARRY BATES, *Secretary of Water Storage Commission, State Capitol, Albany, New York:*

MY DEAR MR. BATES.—At the last meeting of the Commission, I was appointed a committee to recommend certain streams for gauging, provided the United States Geological Survey should have, after the beginning of their new fiscal year (July 1), any funds available therefor. The following streams, in addition to those now being gauged, are suggested:

1. Chemung river.
2. Cohocton river.
3. Tioga river.
4. Two or three stations on Delaware river, as on the West branch, on the East branch and at some point on the Main branch —probably at Port Jervis, or in that vicinity.
5. Neversink river.
6. Tioughnioga river.
7. St. Regis river.
8. Au Sable river.
9. Saranac river.

10. Connewango creek.
11. Cattaraugus creek.
12. Buffalo creek.
13. Onondaga creek. This stream flows through the city of Syracuse and in view of the fact that very destructive floods have occurred thereon, I think it would be well if gaugings were made.

With gaugings made of the foregoing streams, New York State would be fairly well covered. At present I do not think of any others which are of special importance—probably it might be well to submit this letter to Professor Landreth, as he may have some streams in mind which it is desirable to gauge.

At the present time gaugings are made in New York State at something like forty-eight places—a list of which may be obtained from the Report on Gaugings in the Report of the State Engineer and Surveyor—and in case the Geological Survey should see fit to make gaugings at the stations just suggested, there would be more than sixty stations at which gaugings are regularly made. In order to show how this work has increased in the State of New York it may be mentioned that the following stations were established either in connection with the deep waterways work or on the Hudson storage surveys:

GAUGING STATIONS.

1. Seneca river at Baldwinsville.
2. Oswego river at Fulton.
3. Chittenango creek at Bridgeport.
4. Oneida creek at Kenwood.
5. Wood creek near mouth.
6. Fish creek, west branch, at McConnellville.
7. Fish creek, east branch, above Point rock.
8. Salmon river, about one mile above falls.
9. Mohawk river at Ridge Mills.
10. Nine Mile creek, one mile below Stittsville.
11. Oriskany creek, State dam, Oriskany.
12. Oriskany creek at Coleman.
13. Sauquoit creek at New York Mills.
14. West Canada creek at Middleville.
15. Mohawk river at Little Falls.

16. East Canada creek at Dolgeville.
17. Garoga creek, three miles above mouth.
18. Cayadutta creek below Johnstown.
19. Schoharie creek, State dam, Fort Hunter.
20. Mohawk river at Rexford Flats.
21. Hudson river at Fort Edward.
22. Schroon river at Warrensburg.

A station on the Hudson river at Mechanicville was established by The Duncan Company in 1887, and with the exception of Sundays, the gaugings have been kept, I think, continuously from that time to the present. A station on Black river at Huntingtonville was established by the Water Commissioners of Watertown in 1897. For various reasons some of the stations in this list have been abandoned, although, if I remember rightly, it was understood when they were taken over by the U. S. Geological Survey that gaugings be kept up at them for a number of years. However, it is undoubtedly true that some of them were not located at the best points. My part of the deep waterways work was all concluded in one year, and it was impossible to personally supervise the selection of most of these stations. There is frequently considerable time required in order to find the best place on a stream—especially where there is a choice—and I venture to impress upon the Geological Survey the importance of thoroughly examining possible locations before finally selecting one. I think, also, that where fairly good dams exist, gaugings can be made more satisfactorily at such dams than at any other point. A dam is in effect a weir, and as the result of the experiments at Cornell University, recorded in the paper On the Flow of Water Over Dams, of which you have a copy, we now have a series of coefficients applying to different forms of dams through which, provided the dam is fairly regular, it seems to me on the whole, more accurate gaugings can be made than by any other method, but means should be assured for the free admission of air under the nappe, as otherwise there may be an error of 10%, or in extreme cases, sometimes even more.

Probably one reason why the Geological Survey has not made gaugings continuously at the stations originally selected is because of believing that the current meter is a more accurate in-

strument than I am disposed to concede it to be. It seems to me that the current meter is only really useful when the following conditions obtain:

(1) A smooth, uniform channel for a considerable distance on either side of the point selected.

(2) Considerable depth at the point selected and for several hundred feet to either side.

(3) Smooth bottom of either fine sand, hard earth or very fine gravel.

(4) That the current be positive and of some little velocity throughout the whole section.

New York streams as a whole do not, except rarely, answer to these conditions. They are usually shallow, rapid flowing, and frequently encumbered with boulders. The result is that current meter observations are, on most of our streams, practically of little value—they are at times from 100% to 200% in error. So far as most streams in New York State are concerned it seems to me the current meter should not be used except as a last resort. Even under the most favorable conditions in this State it is doubtful if the correct flow within 25% or 30% can be obtained with the current meter. When there are no dams on a stream the current meter is, of course, the proper instrument.

At one time and another I have had occasion to examine the printed record of every gauging made by the U. S. Geological Survey, and I have gone through their reports from the beginning very carefully, examining their records, and in doing this the most striking thing is the absence of long records. A record will continue for two or three years and then suddenly stop, to be continued again a year or two later. It is an interesting fact that the long records of gaugings which exist in this country have been largely made by private parties. I think, therefore, that it ought to be impressed upon the Survey that these records should be kept up continuously, for a considerable number of years—probably ten or twenty years is not too long. There may, of course, be difficulties about the Survey's insuring an appropriation for this work, and possibly this difficulty has interfered with it in the past, and of course I do not wish to be understood as saying that records should be kept up which are beyond the

control of the Survey, but merely to indicate that a fixed, settled policy should be determined upon and the records kept for a long enough time to reveal the peculiarities of every stream.

I am aware that different opinions have been expressed about the current meter, and that engineers have extolled it as an instrument of considerable precision. Nevertheless, I believe that it has been over-estimated and the experience, at any rate in New York State, with shallow, rock-bottom streams, shows that it is a very inaccurate instrument.

As some of the things herein stated may appear to the Commission as possibly a little radical, I may say that they are the result of fairly extended experience. As is known to some members of the Commission, my experience in gaugings is quite extensive, and what is stated, therefore, is not entirely a crude view, but is the result of study, and as such I wish the members of this Commission to take it. Possibly some other engineer member of the Commission may be able to suggest something on these lines which I have not thought of.

Very sincerely yours,

GEO. W. RAFTER.

ROCHESTER, N. Y., *May* 20, 1902.

MR. HARRY BATES, *Secretary of Water Storage Commission, State Capitol, Albany, New York:*

MY DEAR MR. BATES.— I return herewith the copy of minutes of the meeting of the Commission held May 12, 1902, with slight correction. I do not quite understand the third paragraph from the end, on second page, beginning, "Upon motion Professor Landreth was added to the committee on gauges." I did not know of any such committee being appointed and do not quite see to what this relates.

You have not yet returned me my letter in regard to the U. S. Geological Survey's gauging stations. The letter to which I refer is dated May 15, 1902, and contains a list of twenty-four gauging stations, at bottom of first page and top of second. If you will send this letter back by return mail I shall be greatly obliged.

Very sincerely yours,

GEO. W. RAFTER.

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ROCHESTER, N. Y., *May* 15, 1902.

Mr. HARRY BATES, *Secretary of Water Storage Commission, Office of Fish, Forest and Game Commission, Albany, New York:*

MY DEAR MR. BATES.— Mr. James McClintock, of Rochester, has applied for a position during the summer with the Water Storage Commission investigating flood flows on the various streams. He is a young man, now in college, fitting himself for an engineering career, and personally known to me to be exceedingly active as well as very bright. I think there is no doubt about his ability to do the small amount of instrumental work, under the direction of the members of the Commission, required for obtaining the data in regard to flood flows, etc., referred to in another letter, and I wish to suggest his name to the Honorable State Engineer and Surveyor as a proper man to detail for such work, the more especially because he is willing to work for $75 a month, and necessary expenses. Please take this matter up with the State Engineer at your earliest convenience.

Very sincerely yours,

GEO. W. RAFTER.

ROCHESTER, N. Y., *May* 15, 1902.

Mr. HARRY BATES, *Secretary of Water Storage Commission, Office of Fish, Forest and Game Commission, Albany, New York:*

MY DEAR MR. BATES.—At the Syracuse meeting of the Water Storage Commission, it was pretty well concluded that the various sub-committees gather data particularly with reference to extreme floods in the several streams of the State. For this purpose, certain data should be gathered, substantially as follows:

(1) The gauging of floods will necessarily be made at dams and from flood marks that can be found on the ground, or by talking with people in the vicinity. For this purpose, an accurate cross-section of the dam should be made similar to the cross-sections in this paper, On the Flow of Water Over Dams, pages 303-312, inclusive. Such cross-section will permit of applying the proper coefficient from the Cornell University experiments to the said dam.

(2) Examination should be made as to whether means are perfectly assured for admitting air under the dam, as on whether or not a sufficiency of air is admitted will depend the flow within a range of about 10%.

(3) An accurate measurement of the length of crest should be made. For this purpose, until the water becomes low during the summer season, an engineer with each party will usually be required. This, however, need not be a very expensive man — $65 a month will usually be sufficient.

(4) A short distance above the dam, wherever a uniform channel may be found, a cross-section of the stream should be made in order to estimate velocity of approach. During flood flows this may amount to as much as five or six linear feet per second and will materially influence the discharge, especially on a dam of considerable length.

(5) If the dam is at all irregular, a good, careful profile of the same should be made in order to subdivide it into a number of level sections, as explained in the paper, On the Flow of Water Over Dams. A working engineer will also be required for (4) and (5).

(6) In case there are no dams on the streams, information as to flood discharge may still be obtained by taking a cross-section and obtaining from people in the vicinity information as to flood marks at two or three places. For this purpose, a uniform reach of river of considerable length should be selected. The flood marks at two or three places will, of course, give an approximate idea of the surface slope.

Possibly some other engineer member of the commission may be able to suggest some little detail which has not occurred to me. I wish, therefore, you would be good enough to submit this letter to the engineer members for comment and criticism.

Very sincerely yours,

GEO. W. RAFTER.

ROCHESTER, N. Y., *June* 5, 1902.

Mr. HARRY BATES, *Secretary of Water Storage Commission, State Capitol, Albany, New York:*

MY DEAR MR. BATES.—Your letter of June 3, at hand. I herewith return the voucher, made out with items, as required.

I am thinking of going out and doing some work in District No. 2, next week, provided you get the map thereof to me in time.

I do not think I have any corrections to make in the minutes of the last meeting, as sent a few days ago.

Very sincerely yours,

GEO. W. RAFTER.

Owasco Lake Storage.

Mr. Chairman and Gentlemen of the Storage Commission:

I am here to present the question of a greater storage capacity for Owasco lake, for a better supply of water for the feeder of the Erie canal, and also for the prison dam at Auburn. Of course, it is well known to the commission that Owasco lake is situated two and one-half miles south of the center of Auburn, and that the outlet to this lake passes through the city down to the village of Port Byron, where it is an important feeder to the Erie canal. It supplies the water for the Port Byron level, into which it empties directly, and also for the Montezuma level, which is just west of where it enters the canal. The Port Byron level is 10.914 feet higher than the Montezuma level; and the level east of Jordan to Syracuse is 5.580 feet higher than the Port Byron level. The feeder for the Jordan and Syracuse level is the outlet of Skaneateles lake, of which I shall speak more at length hereafter.

The waters of the Owasco outlet fall about one hundred and fifty feet in passing through the city of Auburn, and the power here is fully utilized. North of Auburn very little is used until you get to the State dam at Port Byron which supplies the feeder, although the fall north of the city is something over one hundred and fifty feet. The State has a dam on the outlet adjoining the prison with a fall of five or six feet, the power from which was formerly let with contracts under the contract system, and which has latterly been utilized by the State in supplying electric lights, water and other power for the prison. Thus the State is doubly interested in the storage supply of water at the lake for the use of the canal and the use of the prison dam.

The importance of the preservation of this storage supply was well understood early in the last century, and measures have been taken from time to time to improve the lake as a reservoir in order to get a constant flow of water during the dry seasons of the year.

In January, 1830, Henry Polhemus, Asaph D. Leonard and Allen Warden gave public notice of their intention to apply to the legislature for an act authorizing them to erect a gate in the outlet near the lake to maintain an average depth of water at the foot of the lake of twenty inches during the entire year.

The organization of the Auburn and Owasco Canal Company contemplated the use of the outlet between the upper dam and lake for navigation and hydraulic privileges and from the upper dam northward a canal for like purposes on each side of the outlet. The outlet was to be excavated sufficiently to secure four feet of water by the Auburn and Owasco Canal Company who proposed to deepen the outlet four feet as appears by the deed to the Auburn Woolen Company, March 1, 1847, in which the right was granted to said Woolen Company of drawing down the water of the upper dam whenever the water was low in the outlet, providing that it by its agents should deepen the bed of the stream above the last named point, that there should be a flow four feet in depth from the lake. In 1847 the officers of the Woolen Company, Josiah Barber and William Beach & Co., undertook the work of executing this improvement; the channel above the upper dam was improved by the excavation of rock and removal of obstructions and the bar in the lake was cut through from the *old outlet* to deep water above under the supervision of Eng. E. P. Williams. Piles were driven on each side to hold planking to prevent the sand from again finding its way into the channel. It was soon found that this was a failure from the action of the ice and the treacherous nature of the bar. *Nine thousand dollars* were expended in this work of which sum the State subsequently paid one thousand as its share of the benefit at the prison dam.

It is believed that $25,000 was expended by the mill owners previous to 1852 on this improvement of the Owasco outlet.

Between the years 1852 and 1874, inclusive, between fifty and sixty thousand dollars were expended upon this improvement, one-third of which sum is said to have been paid by the mill owners.

The State engineer and surveyor, McAlpin, made a survey and report to the legislature, which was completed in 1852, for the improvement of the storage capacity of Owasco lake. He esti-

mated that the rain fall of the watershed of this lake was 35.6 inches per annum, and from this he made the deduction that forty-five per cent. of this rain fall passed through the outlet, the remainder being lost in evaporation and from absorption by the earth. He concluded that the flow of water down the outlet was equal to 8541 cubic feet per minute. This estimate is contrary to the experience of the mill owners who know now that the flow was much greater.

The commission will recollect that the city of Syracuse has been granted the right and now obtains its entire water supply from Skaneateles lake, which lies east of Owasco lake some eight miles, and is a feeder to the Jordan and Syracuse level of the canal. The condemnation of the use of this water for the purposes of the city of Syracuse gave rise to much litigation, and the facts in regard to the rainfall and the flow of water were most thoroughly investigated. It was found that the town of Homer, in Cortland county, was a portion of the watershed of Skaneateles lake; that its mean elevation was eleven hundred feet and that the rainfall for a period of thirty-eight years averaged 45.14 inches per year. It appears that Engineer McAlpin made his estimate of the rain fall at the city of Auburn, which is 35.6 inches per year, and where the elevation is seven hundred feet, or four hundred feet less than that of Homer. As a matter of fact the watershed which furnishes Owasco lake is much higher than the elevation of the city of Auburn. The lake itself is higher than the city. The mean elevations of the towns of Moravia, Venice, Genoa, Summerhill, Sempronius and Niles, all of which contribute large areas to the watershed of Owasco lake, is twelve hundred feet. So that it would seem that the rain fall in the watershed of Owasco lake is greater than the rain fall in the watershed of Skaneateles lake.

It was proven in the litigation in regard to the water supply of the city of Syracuse from Skaneateles lake that the entire watershed of the lake was sixty square miles. The city of Syracuse proved and contended that the flow of water per minute from the outlet did not exceed 5,600 cubic feet per minute, while the mill owners contended and produced evidence to show that it exceeded this amount by a thousand cubic feet. Taking this

as a fair average, it is safe to assume that the flow of water in the Skaneateles outlet is at least six thousand cubic feet per minute, but the watershed of the Owasco lake appears by the U. S. Geological Survey to cover two hundred and eight square miles including the lake. A recent survey made under the direction of the Engineer Professor of Cornell University proved that the watershed contained at least one hundred and ninety square miles. Supposing that it was not more than three times as large as the watershed of Skaneateles lake, viz: one hundred and eighty square miles, the flow of water into the Owasco outlet would be equal to eighteen thousand cubic feet per minute, or about two and one-half times as great as that estimated by McAlpin in his survey of 1852.

Estimating then the flow of water at 8,541 cubic feet per minute, McAlpin reported a plan of improvement which he claimed would preserve all this flow of water and allow it to flow regularly through the outlet at the rate of 8,541 cubic feet per minute the year round. At that time the improvements made by Barber and others for the Auburn and Owasco Canal Company had all been obliterated by the movement of the ice and water in the lake and the sand bar was then filled up at the mouth of the outlet. McAlpin recommended the cutting of a new channel at a point in the outlet fully one-half a mile below the bar in the lake directly to the lake itself and through the sand bar and the clearing out of the outlet at that time down to what is known as the upper dam. He recommended that this channel should be at least four feet in depth, and that the height of the upper dam should be increased by the use of flush boards to the extent of eighteen inches. He estimated that there should be a depth of at least three feet of water for the purpose of conveying the water from the lake to the dam and that he would thus give the lake an additional storage capacity of two and one-half feet. Upon the strength of this report the mill owners were induced to take hold with the State and contribute toward the expense for this improvement. The flush boards were put upon the dam and the channel was cut and the banks on each side through the sand bar into the lake were protected by rip-rapping. This improvement was completed finally in about the

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year 1855. In 1868 the Canal Commission decided to add six inches to the height of the dam by flush boards, using a flush board two feet in width instead of eighteen inches, and raising the water in the lake to that extent, thus giving a clear gain of water altogether by both improvements of three feet. He decided also, after careful surveys, that this increase of height of the dam would not increase the height of the water in the lake beyond its original height before the channel was cut and that no damage would be done to the lands of the people at the head of the lake or bordering upon the lake. After this improvement was made, some twenty-two claims were filed for damages. It was stipulated in all these claims that the award made in the case of Seymour J. Fordyce, whose claim was to be tried, should be the basis of the decision and binding upon each of the other claims in the case. His claim was tried and evidence taken for nearly a week. After careful consideration, the Canal Appraiser decided that no damage had been done to his lands and awarded him nothing. He appealed to the Canal Board where the case was finally affirmed. In 1871, Canal Commissioner Wright, having this section in charge, made a report to the legislature which will be found in Assembly Document No. 6 of 1871, in which he stated among other things the following:

The Owasco lake improvement is now completed and renders the water of that lake available to a point three feet below the ordinary stage during the season. It is liable to be wholly emptied as a reservoir in any year of low water, as was its condition last year (1870) and the canal but partially supplied from that source; in which case the Port Byron level must be supplied by drawing through the canal from the Jordan level. More water can be obtained from the Owasco lake however, by raising the dam at the foot (of the lake) and converting it into a reservoir by thus raising the surface. I have ordered a survey and estimate to be made of the cost of raising the dam to such a height as will retain and hold the water of the lake at a point two and one-half feet higher than at present.

Thus it will be seen that Canal Commissioner Wright, after careful surveys in 1871, recommended precisely what the mill owners recommend to-day and what I am here to advocate, the

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raising of the height of the lake, or the raising of the flow from the lake, two and one-half feet; I would suggest three feet, by adding two feet to the height of the dam and by lowering the channel another foot. This would make an additional storage of three feet, or just double that proposed by Engineer McAlpin in 1852. The legislature adopted Mr. Wright's plan and passed the following law in the session of 1871:

Chapter 930, Laws of 1871

The sum of fifteen hundred dollars is hereby appropriated for the construction of a bulkhead, or other adequate structure in or upon the outlet of Owasco lake for the purpose of storing water in the Owasco lake for canal purposes. Said sum, or so much thereof as may be necessary, to be expended by and under the direction of the canal commissioner in charge of the middle division of the Erie canal.

The canal board was abolished in January, 1872. Mr. Shanahan took control of the canals as superintendent of public works. Instead of carrying out the plan of Commissioner Wright, he adopted the plan of keeping the flush boards of the dam at the height of two feet the year round instead of placing them there only during the summer months as had been done hitherto. He maintained these flush boards at that height for a period of twelve years, until 1884. At times during the winter with these flush boards there was three feet six inches of water flowing over the top of the flush boards, for at flood times the lake has been known to be seven or eight feet higher than at mean water. It was at one time during this period that the person in charge removed the flush boards and opened all the waste gates of the upper dam letting the water down in torrents. This destroyed the State dam and did much damage to several private dams upon the stream. Mr. David Wright, who owned a farm at the head of the lake, brought an action first against Nelson B. Eldred in favor of his tenant, one Shaver. In the defense, among other things, there was raised the point that Eldred was simply acting for the State and could not be held individually liable. It was also proved in this case that the water was not higher with the flush boards than it was before the State made any im-

provements in the deepening of the channel, etc. This case will be found reported in 114 N. Y., at page 236. Defeated in this Mr. Wright brought an action against Mr. Shanahan, the superintendent of public works, for an injunction requiring him to remove these flush boards and also for damages. This case went to the Court of Appeals and Mr. Wright finally recovered on the ground that Shanahan had no right to keep the flush boards on the dam or to put them on while the water was flowing over the dam at a greater height than two feet above the crest of the dam without the flush boards. This case will be found reported in 149 N. Y., at page 495. But the court also decided that the State was entitled to maintain the flush boards at the height of two feet above the dam at all times when the water was not higher than the top of flush boards.

So it has come about that this improvement recommended by Commissioner Wright, and approved by the legislature in 1871, has never been made, while there is an increased necessity for the use of the water. The improvement by McAlpin contemplated a channel twenty-five feet in width at the bottom. This the State has never obtained, although it approximated towards it when the improvement was first contemplated in 1856. Of course, the sands have been drifting into the channel from time to time and the State has made appropriations to remove them. Formerly the contractor, for his own convenience, dumped the sand between the walls of the channel, on either side so that they soon drifted back into the center of the channel, and the money expended was entirely lost to the State. Latterly they have been pumping the sand out of the channel and discharging it beyond the walls.

The riprap wall proved insufficient, the ice breaking through it and the sand coming in on either side into the channel. Latterly the State has built a heavy stone wall upon one side and driven a row of piles upon the other, which seems at present to furnish adequate protection.

The use of water in the city of Syracuse with its large increasing population from year to year, of course, becomes much greater, so that it now seriously threatens the Skaneateles outlet as a feeder to the Jordan level. It is understood, (the State

engineer will know much better than I as to the fact,) that a survey has been made for the purpose of lowering the Jordan level and increasing the level between Port Byron and Jordan so that the entire level could be fed from the Owasco outlet as well as the level in the city of Syracuse which is lower. Surveys made before by the State and by individuals have clearly shown and it was reported to the legislature by Canal Commissioner Wright that an increase in the height of the upper dam would not damage the lands bordering on the lake to an extent exceeding one hundred acres to every foot of increase in the height of the dam. I think there can be no doubt as to the accuracy of these surveys.

The reason for the inaccuracy of Surveyor McAlpin's estimate of the flow of water arises from three facts, which he seems to have failed to take into account. He estimated the rain fall at Auburn, which is between four and five hundred feet below the mean level of the watershed of Owasco lake. The higher level would show at least ten inches of additional rain fall. He failed to take into consideration the character of the soil in this watershed, much of it being rocky and impervious to water. He failed to take into consideration the amount of water held back in snow and ice in the spring time, some of it not reaching the streams flowing into the lake until the latter part of May in each year. He also made a fatal error in estimating the extent of the watershed, putting it at one hundred thousand acres as appears on his map, equivalent to about one hundred and fifty-six square miles, which is thirty-eight square miles less than the Cornell survey. This fact alone would add twenty-five per cent. to the amount of water. The latter estimates founded upon the Skaneateles litigation are confirmed by the observers of the flow of water at every point along the stream. We ask that a survey be made in order to confirm and set at rest the facts which we have stated in this presentation of the case as soon as it can be made, that the legislature may intelligently take up the subject of the re-enactment of the legislation of 1871 providing for an increase of storage of water in Owasco lake.

The act providing for this commission seems to have been inartistically drawn at least and perhaps fails to give the com-

mission the power intended. The act named the commission "The Storage Commission." One section of it provides for an examination into floods and their causes, but it was evident that the whole subject of storage thus conserving the waters of the streams and lakes for the State's use was uppermost in the minds of the legislature in passing the act. We believe that it ought to be amended to fully and clearly define the powers of the commission, and yet under the act itself we believe that it is the duty of this commission to recommend an appropriation for this survey, which we ask.

The State needs the water. The district superintendent often calls for it in the dry season without avail. An increased storage capacity will increase the power of the State dam at the prison. Something is due to the mill owners in Auburn, who upon the faith of the report of the State engineer in 1852 and at other times have contributed their money, believing that the result would be the storage of all the water supply of the watershed of Owasco lake. The State, of course, will keep faith with its citizens. On every principle of equity and justice, as well as for the benefit of the State, we trust we may have the aid of the commission in prosecuting this improvement.

SERENO E. PAYNE.

December 31, 1902.

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APPENDIX No. 3.

Supplemental Matter from Third Division.

Report on Freshets in the Hudson River, by the Flood Committee of the Albany Chamber of Commerce and sub-committees at Troy, Watervliet, Rensselaer, Castleton, Coeymans and New Baltimore, with maps and photographs.

REPORT

OF

COMMITTEE ON FRESHETS IN THE HUDSON RIVER OF THE ALBANY CHAMBER OF COMMERCE

AND

SUB-COMMITTEES

AT

TROY WATERVLIET, RENSSELAER, CASTLETON, COEYMANS AND NEW BALTIMORE

WILLIAM BAYARD VAN RENSSELAER, *Chairman*
WILLIAM B. JONES, *Secretary*

December, 1902

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COMMITTEE

ON

FRESHETS IN THE HUDSON RIVER

OF THE

ALBANY CHAMBER OF COMMERCE.

WILLIAM BAYARD VAN RENSSELAER, *Chairman.*
WILLIAM B. JONES, - - - *Secretary.*

ARTHUR L. ANDREWS,
JOHN BOWE,
A. S. BRANDOW,
JOEL W. BURDICK,
WILLIAM BURGESS ELMENDORF,
CHARLES H. GAUS,
EDWARD N. MCKINNEY,
WILLIAM P. RUDD.

SUB-COMMITTEES.

ALBANY.

Common Council.

JOSEPH BESCH, THOMAS F. MARTIN, HERBERT H. BUGDEN.

TROY.

Chamber of Commerce.

FREDERICK W. ORR,
E. T. MURRAY,
ARTHUR G. SHERRY,

Common Council.

MARSHALL L. BARNES,
PATRICK COFFEE, JR.,
JOSEPH F. HOGAN.

WATERVLIET.

JAMES C. WILBUR, PETER A. ROGERS, JOSEPH HOLLANDS.

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RENSSELAER.

BRADFORD R. LANSING, C. A. BAILEY, WILLIAM SMITH.

CASTLETON.

Board of Trade.	*Board of Trustees.*
THOMAS CLIFFORD,	GEORGE ANDERSON,
H. H. G. INGALLS,	WILLIAM C. CORTS,
L. S. KELLOGG,	WILLIAM P. SMITH,
JACOB SEAMAN,	JOEL D. SMITH,
O. D. WOODFORD,	C. D. WELCH, M. D.

COEYMANS.

L. A. CARHART, P. A. WHITBECK, C. F. SUDDERLY, JR.

NEW BALTIMORE.

WM. H. BALDWIN, A. J. VANDERPOOL, WM. D. FULLER.

FRESHETS IN THE HUDSON RIVER.

INTRODUCTION.

The committee appointed by the Albany Chamber of Commerce to investigate the damage done by the freshets in the Hudson River would respectfully report that they organized and commenced work on March 4th, 1902, and as soon as possible after this date, organized sub-committees in Troy, Watervliet, Rensselaer, Castleton, Coeymans and New Baltimore.

Work of Committee.

The principal work of the committee has been that of investigating the damage caused by the freshet of 1902. Several reference tables have been prepared which give, in concise form, statistics regarding the Hudson River freshets and the damage done by them.

Tables.

Table No. 1, which was furnished by Mr. Alfred F. Sims, Local Forecast Official, gives an idea of the important freshets in the Hudson River, beginning with the year 1839. Under remarks, in connection with this table, some idea may be gained regarding the condition of the Hudson River at the time of these freshets.

Table No. 2 shows a partial record of the buildings in the inundated districts in some of the places investigated.

Table No. 3 gives a partial record of the damage to property, loss in wages, depreciation in value of real estate, etc. This table, of course, does not give a complete record of the damage done, as it is utterly impossible to estimate the loss in dwelling houses, stores, etc., occasioned by the high water.

Pictures.

The pictures which form a part of this record give still better ideas of the inundated district in the several cities and villages. (These pictures will be found between pages 528b and 529.)

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MAPS.

The maps give a faint suggestion of the inundated districts in Albany, Troy, Watervliet and Rensselaer.

FRESHET OF 1902.

The freshet of 1902 commenced on February 28th and lasted until noon on March 5th, when the water in the river receded to a point below the level of the docks. A complete record of this freshet will be seen by the following table, which was furnished by Mr. Alfred F. Sims, the Local Weather Forecast Official:

RECORD OF FRESHET.

February 28th —

River rose slowly during the day.

March 1st —

7 A. M.: River reached to the top of wharf at the foot of State street.

8 A. M.: River 10.6 feet.

River fell 4 inches shortly after 8 A. M.

4 P. M.: River rose 10 inches between 3 and 4 P. M.

4:30 P. M.: River fell 10 inches between 4 and 4:30 P. M.

11:15 P. M.: River rose from 10 P. M. to 11:15 P. M., when it reached a 17.00-foot stage.

Midnight: River rose steadily.

March 2nd —

10:15 A. M.: River 17.76 feet above mean low water of 1876, after this river began to fall slowly and continued to midnight.

March 3rd —

Ice came down from the upper Hudson after midnight, and, in gorging south of Albany, caused the water to back to Albany; water in Hudson at Troy, N. Y., fell at 10:20 A. M. Gorge remained firm during the afternoon, but the freshet water, in finding an outlet through Schodack Creek, relieved Albany. Highest water at noon to-day, 18.28 feet.

March 4th —

Hudson River fell 2.6 feet from 5:30 P. M. of 3rd to 8:00 A. M. of 4th; no floating ice in river at 7:30 A. M. River continued to fall during the day.

March 5th —

8 A. M.: River 10.6. At noon river was within its banks.

EFFECT ON BUSINESS.

During the freshet of 1902 business along the river front in the cities and villages between Troy and New Baltimore was practically suspended. Railroads were tied up and trolley lines unable to run their cars. This high water not only affected the cities and villages, but all of the low lands between Troy and Stuyvesant were flooded and buildings submerged, in some instances the water coming in dwelling houses on the second floors, and a very large amount of damage was done. Ice houses along the river front were also damaged to a great extent by the high water and the floating ice.

Some of the conditions existing in the several cities and villages between Troy and New Baltimore during the freshet of 1902, the committee found to be as follows:

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ALBANY.

Albany is more or less affected by freshets in the Hudson River every Spring. The most noticeable, however, of these freshets during the past few years, being the one of 1900 and the one in the Spring of 1902; the latter freshet covered a large portion of the city at the river front, as will be shown by the map opposite page 17.

The Inundated District.

As a result of this freshet 109 wholesale houses, 95 stores and 123 other places of business were closed; 67 factories shut down, the water in some instances reaching a depth of 8 feet on the factory floors, and in many instances reaching a depth of 3 and 4 feet; nearly 3,600 families were also driven entirely, or partly, from their homes, and business east of Broadway, from North Ferry to Gansevoort streets, was practically at a standstill.

United Traction Company.

The lines of the United Traction Company were disabled from Sunday at 6 A. M. until Tuesday at 3 P. M., and travel over all of their lines, not only in Albany, but in Rensselaer, Watervliet, Troy, Lansingburgh, Green Island and Cohoes, was abandoned. The freight service of the road was also stopped.

New York Central and Hudson River Railroad Co.

The New York Central and Hudson River Railroad Company were obliged to run their trains from the South into Albany by the way of Hudson and Chatham, their entire tracks between Stuyvesant and Albany being submerged and piled in many places high with ice. The cost to the Railroad Company to clear their tracks and put them in shape was over $200,000. The New York Central freight houses on Spencer street were surrounded with water to an average depth of between 3 and 4 feet, and for nearly two days business here was practically suspended.

DELAWARE AND HUDSON RAILROAD CO.

The Delaware and Hudson Railroad Company were unable to run their trains into the station either on their north or south-bound tracks. The trains on the Saratoga division could not reach the station for two days on account of the high water, and those of the Susquehanna division were unable to reach the station for four days; the tracks south of the station were submerged from Hamilton to Columbia streets, and on the north from Thatcher street to lock 2 on the Erie canal. The Delaware and Hudson freight house, located in the south part of the city near the foot of Gansevoort street, was surrounded by water, averaging from 2 to 3 feet in depth, and in about half of the building the water came on the floor. A large force of men were employed removing the freight from the freight house to cars, which were run out of the city and placed on side tracks.

LUMBER DISTRICT.

The Lumber District was covered with water at an average depth of about 2 feet, and on some office floors the water was from 8 to 10 inches deep. The freshet damaged many of the yards and slips; about 100,000,000 feet of lumber was stored in the several yards, which was damaged to the amount of $10,000.

WHOLESALE HOUSES.

The wholesale houses along Broadway from State street to the south part of the city were more or less damaged; the water averaging 3 inches on the floors of those located near Hudson avenue, and 6 feet on the floors of buildings located on the river front at Madison avenue. The wholesale merchants in many instances are prepared for these annual freshets, and the perishable goods on the first floors of their stores are either left during the entire year on racks which are built above the high-water mark or else are lifted to the second floors before the ice in the river begins to break up. A large number of merchants, however, have their goods damaged to a great extent each year. On the State Street Pier the water was 8 feet deep.

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DWELLINGS.

The private houses are also damaged with every freshet, there being over 3,500 dwelling houses in the flooded district in Albany. Some of these families are driven entirely from their houses, while others are compelled to live on the upper floors. It is impossible to estimate the cost of the household goods damaged, in many instances the water rising so rapidly that not even the carpets can be taken up. The water during the freshets backs up through the sewers into the basements and cellars of nearly 2,000 additional dwellings and business houses.

GOVERNMENT BUILDING.

In the Government building at Broadway and State streets the water was 2 feet deep in a part of the basement. During the freshet of 1900 the water in this basement reached a depth of nearly 5 feet, damaging a large quantity of bonded goods in storage. After this freshet a protecting wall was built which prevents the water from entering certain parts of the cellar.

HOTELS.

Five hotels were in the submerged district, two of them suffering great inconvenience. At Stanwix Hall water began coming into the cellar on Saturday, March 1st, and continued rising until it reached a depth of 6½ feet, and then fell to a depth of 6 feet, where it remained until Tuesday, when it began falling. The water ran into the boiler room, putting out the fires and causing the hotel to be without steam several days. The hotel lost, at a low estimate, $2,000. The Mansion House also suffered a considerable loss; the water was 6 feet deep in the cellar, nearly covering the boiler, and the hotel was without steam three days.

CHURCHES AND SCHOOLS.

The three churches and three schools which were in the submerged district also sustained considerable damage.

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DEPRECIATION IN VALUE OF REAL ESTATE.

The damage to buildings caused by these annual overflows cannot be estimated with any degree of accuracy, but according to reports in the Department of Assessment and Taxation for the years 1900–1901–1902 the net decrease in the value of real estate in the five river wards was $696,460, which decrease is largely due to the fact that property in these wards depreciated in value on account of the Spring freshets.

TABLES.

By referring to table No. 3 some idea of the loss in wages, damage to property, etc., in Albany can be gained. This amount does not include, however, the damage to the stock in a large number of wholesale or retail stores or household goods or supplies in any of the private houses.

Table No. 2 will give some idea of the number of buildings in the district under water.

TROY.

Troy has suffered from the effects of three notable freshets. The first was in 1857, the second in 1886, and the third in 1902. The two former resulted in the greatest damage, owing to the fact that owners of property in the submerged district were less prepared for it. At present freshets are anticipated as annual occurrences, and perishable and other goods are removed to upper floors or other buildings. The actual damage, except to property on Front street, is comparatively small.

Record of Freshet.

The freshet of 1902 began Sunday, March 1st, at 6:30 A. M., when the ice broke up. The ice above the dam began moving at 7 o'clock. That in the west channel opposite Centre Island began moving and collided with the ice that was packed in at the Congress street bridge, and was forced to the shore. The large cakes of ice struck the docks at State street, crushing in the sheds of the Murray Line. The fence on the Troy and Albany dock was swept away and other damage done which amounted to $500. The dock of the Citizens' Line was flooded and damaged.

At O'Neil's coal yard masts and derricks valued at $300 were swept away, and some damage done to the dock of the Troy and Newburgh Line. Front street was flooded and the water was in all the buildings and considerable damage done to their contents.

The large piles of lumber in Bayer & McConihe's lumber yard were saved by using heavy ropes and anchoring them.

The tracks in the Adams street freight yard of the New York Central and Hudson River Railroad were under water, and the power and heating house was flooded.

River street from Division street to Adams street was two feet under the water, and the cars of the United Traction Company were stopped at Division street. Passengers were transferred by carryalls to the corner of Second and Adams streets.

DEPTH OF WATER ON FRONT STREET.

At Federal street from six to eight inches; at Grand street, 15 feet between the pier and Front street and five to six feet in the street. On the floor in the shop of Williams & Manogue, from six to eight inches.

At Fulton street, two feet, and the cellars were flooded. In the cellar of J. M. Warren there were six feet of water, and a large quantity of barbed wire was damaged.

At State street, eight feet, and considerable damage was done to Kimmey's ice house. The rear of a building occupied by Barnum Brothers, belt manufacturers, was damaged.

At Congress street, six feet; buildings of Troy and Newburgh Line lost 150 bales of rags.

At Ferry street, about six feet deep between Front and River streets.

At Liberty street, 26 inches, and the water was half way to First street, crossing River street.

MORE STREETS FLOODED.

Owing to the high water in the river, it ran into the sewers and flooded the lower or southern part of the city, the land at some points being lower, back from the river, than at the river front. On First street, between Polk and Liberty streets, the average depth in the cellars was three feet. At the Troy Stamping Works on Second street it was two feet in the cellar. On Third street, between Liberty and Division, it averaged from two to three feet. On Fourth street, from Liberty to Congress, eight to nine inches, and on Fifth avenue, from Ferry to Fulton street, two feet.

SCHOOLS AND CHURCHES.

School 12, on First street, was closed a week, causing 18 teachers and 500 scholars to be idle. School 9, at the corner of Liberty and River streets, and School 10 were closed several days. There were between two and three feet of water in the basement of St. Mary's Church, and the fire in the heater at the Washington Volunteer steamer house was put out by water.

FRESHET OF 1886.

The photographs of scenes in Troy, accompanying this report, are of scenes witnessed during the memorable high water of 1886. The river began rising during the evening of February 14th, and at 10 o'clock the danger of a freshet became so apparent that Chief Engineer Lane of the Fire Department ordered the church bells to be rung. This was done, and soon after the streets were filled with excited people. Bales of wool and cotton on the steamboat dock were submerged. The ice was piled 15 feet above the wharf. At midnight it was supposed the water was receding, and the streets were deserted at 1 A. M. About half an hour after, the ice became gorged near the Burden works and piled up about 20 feet. The water rose until it put the fires out in The Electric Company's building, and the city was left in darkness.

People who went to church found difficulty in getting to their homes. From Ferry street south the streets were like canals. First street was filled with water, and at the junction of First and Second streets it was 42 inches deep, extending to Polk street. People attending services in the South Baptist Church were taken home in boats. Liberty from the river to Fourth, Ferry from Fourth to about 100 feet west of Fifth, and Fourth for a space of 500 feet north and south of Ferry street were flooded. On Ferry street it was within three inches of being as high as in 1857.

TABLES.

Tables Nos. 2 and 3 will give further statistical information regarding the freshet of 1902, and the map opposite page 27 will give some idea of the area covered by the high water.

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WATERVLIET.

The freshets which affect the city of Troy also do a large amount of damage to the city of Watervliet. This was especially noticeable in the freshet of 1886 and a former one in 1857. The freshet of 1902, while it affected a large number of interests in the city and did considerable damage, yet the loss resulting from this high water was not as great as the damage caused by the two previous inundations.

Area of Inundation.

During the 1902 freshet the water flooded Broadway from a point near First street to the corner of Thirteenth street. From Thirteenth street to Sixteenth street the water covered only the docks east of Broadway; at Sixteenth street the water again crossed Broadway, reaching a point beyond and to the west of First avenue. The entire section between First avenue and the river was covered up to Twenty-fourth street. A large number of business houses were under water, and a still larger number of dwellings inundated, the merchants losing a large amount of their stock, while in the residential section a considerable amount of household goods were damaged. It is impossible to estimate with any degree of accuracy the amount of damage done by these overflows of the Hudson River. A better idea of the flooded district can be obtained by referring to map opposite page 516.

RENSSELAER.

Rensselaer suffers almost annually from high water in the Hudson River, the amount of damage varying each year. It is a matter of general observation, however, that the freshets seem to become more damaging as the years occur.

The Inundated District.

The entire lower end of the city was inundated during the high water of March, 1902. Business houses were closed, and a large number of dwellings had water on their first floors. Fifteen families were driven entirely from their houses, while about 100 were driven from their basements and first floors.

On Broadway at Aiken avenue the water reached a depth of four feet, and on Broadway at Columbia street the water reached a depth of about two feet.

Albany and Hudson Railway and Power Co.

In the barns of the Albany and Hudson Railway and Power Company the water reached a depth of 18 inches on the main floors, causing great damage to the cars and motors, which were soaked with water; the water around the building was from six to eight feet deep. The engines and boilers of the company were badly damaged, as well as their gas and electric light business.

Mills.

The Felt Mills of F. C. Huyck & Sons located in Rensselaer eight years ago; the mills have suffered from extreme freshets five years out of the eight. During the freshet of 1900 the water reached a depth of 15 inches on the first floor of their mill, shutting the mill down for over a week, and damaging the machinery and merchandise to an extent of several thousands of

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dollars. After the freshet the Company spent $20,000 in raising their engines, boilers and stock rooms and other parts of the mill to avoid trouble from high water. This Company, however, sustained considerable damage to the building and stock during the freshet of this year.

These annual freshets mean, practically, the closing up of all the business portion and a great part of the residential portion of the south part of Rensselaer. The map opposite page 17 shows the flooded district.

CASTLETON.

During the ordinary high water in the Hudson River the docks at Castleton are always covered with water, and the contents of buildings on these docks damaged to a certain extent. It appears, however, that when the ice gorges in the river at points below the village of Castleton, the water backs up not only in cellars of the buildings along Main street, but also on the tracks of the New York Central & Hudson River Railroad Company, as well as in the village streets which runs parallel to the river.

The Inundated District.

During the freshet of 1900 the water was about four feet deep in Main street at its deepest point, while in the freshet of 1902 the water reached a depth of from six to seven feet; the upper part of the village north of the North Road was filled with water and floating ice, and it was necessary when the water receded to cut a carriage way through the ice deposited in the road. The water again came into Main street at a point near the Middle Road, and from that point south it increased in depth, reaching a depth at the corner of South and Main streets, or in the center of the business section, of 3½ feet. In the dwellings situated on the corner of Main and South streets the water reached a depth of three feet on the floor, and on the opposite corner, at the store of Richards Bros., it reached a depth of four feet on the store floor. All of the stores in the village were in the submerged district. The water was 23 inches deep on the Post Office floor. Further south on Main street the water became deeper until a depth of about seven feet was reached. The tracks of the New York Central & Hudson River Railroad were completely covered with water and ice, and three trains were stalled at the village. Water on the tracks in front of the

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station reached a depth of 12 inches. Merchants along Main street anticipated the high water, and a large amount of their stock was carried up into the second floors of their buildings, thereby decreasing the damage to a great extent. When the water receded the streets and yards were filled with cakes of ice, and driftwood of all kinds; this caused an immense amount of labor in removing the same and putting the streets in passable condition.

The people of the village of Castleton, from a hygienic and sanitary standpoint, are forced to face a greater degree of danger than perhaps any community affected by the spring floods of the upper Hudson.

Words and photographs both make convincingly plain the degree to which Castleton suffered during the freshet of 1902. But while it might not be difficult to find facts and figures for a nearly correct estimate of the loss to business and damage to property, it is not so easy to accurately make accounts of the physical injury and peril coming to the people as a result. The Spring of 1902 saw very many persons sufferers from severe and continued catarrhal colds, many children victims of sore throat, and "malarial" symptoms very prevalent, and all this predominating along the line of submergence. It can be very reasonably claimed that cellars flooded and walls and floors for days soaking under several feet of icy water furnished ample cause for the unusual number of cases of catarrhal trouble occurring in Castleton so closely subsequent to the freshet. Many days were, under the best of conditions, required to clean up, dry, and place in good sanitary state the many business places and residences so long beneath the cold and dirty waters.

It would not be hard to give in this connection a lengthy and detailed report, but the facts are so strongly and clearly in evidence that more is not required.

Again the village is subjected through the river's overflow to a danger which, while not perhaps as immediately evident as that resulting from damp and cold, is yet considered one of grave import. Unfortunately, Castleton has no sewage system, and while many water-closets connect with private drains, a large percentage of disconnected or out-of-door closets are simply

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boxes resting on the surface, or very shallow pits. Thus it occurs that at the time of inundation a very considerable portion of the contents of these disconnected closets is washed out and away by the rising water and distributed by the same. A certain amount either in solution or as solids must necessarily find lodgment in structures or fall as a deposit to the surface of the streets or adjoining property. The possible result of this condition is certainly greatly to be feared.

Castleton is ordinarily a healthful village and the death rate usually low, but it is feared and thought justly so that repeated floods such as was experienced in the Spring of this year must change the record.

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COEYMANS.

Coeymans being situated on a bluff at the side of the river, the only damage occasioned by the freshets in the Hudson River is to the docks and buildings on the same, and other buildings situated at the foot of the hill and along the river front.

During the freshet of 1902 the water at the head of the docks was 10 feet deep. There was also four feet of water in the dwellings which are located on one of the docks, and the water in the store and freight house on the dock was six feet deep. A large amount of goods were in the store and freight house, and were damaged to an extent of about $8,000.

NEW BALTIMORE.

Like Coeymans, New Baltimore is situated on a hill on the west side of the Hudson River, and no great amount of damage has ever been done by the freshets which occur almost annually in the Hudson River.

The ice which gorged at a point below New Baltimore together with an apparent obstruction, in the form of a dike in the river opposite the village, caused the water to cover the docks and flood the stores, factories and houses along the river front. The ice piled up on the north dock, carried away a part of the dock front, and did a great amount of damage to the coal sheds and offices on the dock.

The ship yards of William H. Baldwin were completely inundated and a great amount of damage done there. Several dwelling houses were also damaged by the water and the ice.

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CAUSE AND REMEDIES.

After the committee had carefully investigated the damage occasioned by the freshet of 1902, they turned their attention to looking into the cause of these annual freshets, with an idea of suggesting remedies for the same, but in view of the fact that commissions of experts — the Commission of Army Engineers, appointed by President Roosevelt, and the Water Storage Commission, appointed by Governor Odell — are to make reports on these subjects in the near future, we feel delicate in making suggestions until after these reports are made.

In Conclusion.

The committee, in closing, however, wishes to emphasize the fact that these annual overflows of the Hudson River, which cause so much sickness, damage and inconvenience, should be given immediate attention, and every possible effort put forth by both State and United States Government to prevent their occurrence.

TABLE NO. 1 — A.

Freshets and Ice Gorges in the Hudson River.

YEAR	Month.	Elevation.	Remarks.
1839..	January 27.....	17.78	
1846..	March 15.....	18.27	
1857..	February 9.....	21.16	
1869..	April 22, Oct. 4, 5 ...	18.52	Heavy rain (11 inches at Coeymans, N. Y.).
	January 11, Mar. 31..	.....	
1875..	April 3.....	.....	River 7 feet above docks.

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TABLE NO. 1 — B.

FRESHETS AND ICE GORGES IN THE HUDSON RIVER.

YEAR.	Month.	Elevation above M L W. 1876.	REMARKS.
1876..	February 16.....	14.6	
1877..	March 30.....	.....	No bad dam formed so far as known.
1878..	March 5.....	.....	No bad dam formed so far as known.
1879..	March 27.....	.....	No bad dam formed so far as known.
1880..	February 14, Jan. 28.	.....	Trains on Susquehanna R. R. could not start from depot on account of high water. Heavy rainfall; river rose 11 feet in 36 hours.
1881..	Feb. 12, Mar. 1, 18...	.....	Gorge formed between Stuyvesant and lower Kinderhook light.
1882..	February 14.....	.....	River 12 feet above mean tide.
1882..	March 1–8.....	.....	Ice gorge formed at Douw's Point.
1883..	March 28.....	.....	No dam formed so far as known.
1884..	February 8, 14, 15, 18, 22, 24, 26.....	15.45	Ice dam at Van Wie's Point; dam at Four-Mile Point.
1885..	April 1–4.....	.....	Ice gorged at Van Wie's Point and Quay street submerged.
1885..	January 1.....	.....	Ice lodged on the "Overslaugh."
1886..	March 14–26.....	17.89	Ice dam at Pleasure Island. Troy inundated.
1886..	Jan. 4–8, Feb. 13.....	.....	Ice dam bet. Castleton and Coeymans.
1887..	April 11–May 5.....	.....	Docks and R. R. tracks submerged. People's Line boats could not land at their docks until after May 5. Ice gorge at Nuttenhook.
1888..	Dec. 18, April 1–7....	.....	Docks submerged. State and Dean streets covered.
1889..	.....	.....	No dam formed so far as known.
1890..	.....	.....	No dam formed so far as known.
1891..	February 27.....	.....	Ice dam formed south of Albany and remained until March 14.
1892..	January 15.....	.....	Water in cellars on Broadway. No bad dam so far as known.
1893..	March 14.....	19.00	Ice piled to a depth of from 20 to 30 feet. Some of the ice was nearly 3 feet thick.
1894..	March 7.....	16.12	Ice dam from Cedar Hill to N. Coeymans.
1895..	April 10.....	16.54	Melting snow and rain.
1896..	March 1.....	17.78	Much damage done to railroad by water and ice which flooded the tracks as far as Stockport. The ice finally stopped at Four-Mile Point and remained until some time in April.
1897..	.....	.....	Ice moved out easily.
1898..	March 13.....	13.80	No bad dam so far as known.
1899..	March 6	12.45	Gorge at Van Wie's Point opposite Castleton and below North Coeymans.
1900..	February 14.....	19.96	Gorge below Kinderhook Upper Light, between Coeymans — north end of Castleton U. S. Government dike to Cow Island Light.
1901..	December 12.....	13.56	Gorge below Stone House Bar.
1902..	March 3.....	18.26	Gorge below Stone House Bar.

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TABLE NO. 2.

BUILDINGS IN FLOODED DISTRICT.

ALBANY:

Dwellings	3,528	
Saloons	118	
Wholesale houses	109	
Stores	95	
Factories	67	
Unoccupied buildings	35	
Hotels	5	
Churches	3	
Schools	3	
Police stations	1	
Total		3,964

RENSSELAER:

Wholesale houses, factories and stores	20	
Dwellings	100	
Total		120

CASTLETON:

Dwellings	65	
Stores	21	
Factories	3	
Churches	2	
Total		91

COEYMANS:

Dwellings	14	
Stores	3	
Total		17

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NEW BALTIMORE:

Dwellings	7
Storehouses	8
Hotels	1
Factories	1
Total	17

TABLE NO. 3.

DAMAGE TO PROPERTY — LOSS IN WAGES — DEPRECIATION IN VALUE OF REAL ESTATE, ETC.

ALBANY:

The 204 wholesale houses and stores lost in damage to goods, etc.	$24,000 00	
59 factories, employing 2,042 hands, were stopped from 1 to 12 days, loss in wages	15,208 00	
Families assisted by the city to the amount of	1,689 42	
In the Lumber District, estimated loss to lumber, etc.	10,000 00	
Depreciation in the assessed value of real estate in five river wards since 1900	696,460 00	
Total		$747,357 42

The New York Central paid to clear and repair tracks between Troy and Castleton	$200,000 00
The D. & H. paid to clear and repair tracks and for damage resulting from the impossibility to run trains into station	3,000 00
The United Traction Co. lost in fare.	5,000 00

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The employees of the United Traction Co. lost in wages	$2,625 00	
The Electric Express lost in freight.	450 00	
Total		$211,075 00

TROY:

24 wholesale houses, stores, etc., lost in damage to goods	$8,125 00	
18 factories, employing 6,373 hands, were stopped from 1 to 21 days, loss in wages	31,415 00	
Total		39,540 00

RENSSELAER:

500 hands in factories idle 1 to 3 days	$1,200 00	
Albany and Hudson Railway and Power Co. reported a loss in damage and stoppage of business of	15,000 00	
Total		16,200 00

CASTLETON:

Damage to buildings and contents.	$14,020 00	
3 factories, employing 190 hands, were stopped from 1 to 5 days, loss wages	350 00	
Depreciation in value of real estate.	25,000 00	
Total		39,370 00

COREYMANS:

Damage to buildings and contents.	$12,000 00	
50 persons out of employment, loss in wages	100 00	
Total		12,100 00

NEW BALTIMORE:		
Damage to buildings and contents..	$25,000 00	
250 persons out of employment, loss in wages	450 00	
Total		$25,450 00
Total		$1,091,092 42

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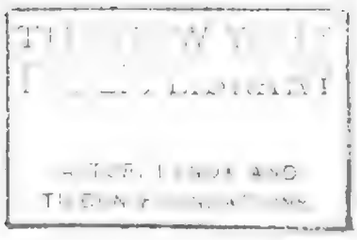

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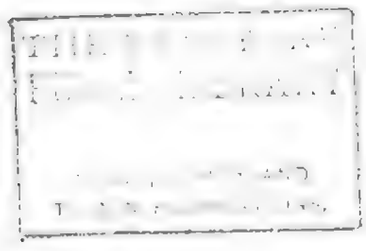

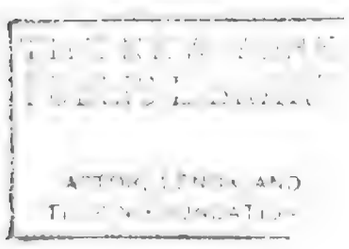

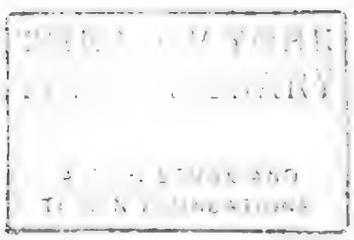

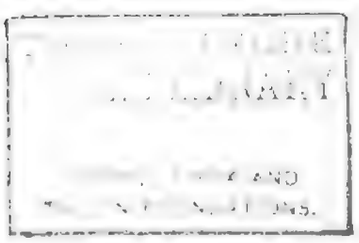

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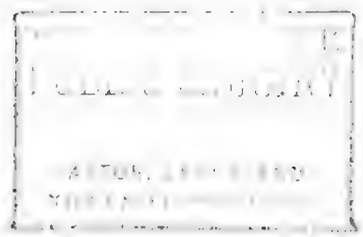

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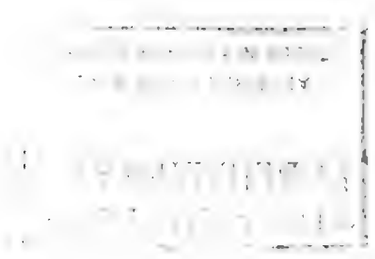

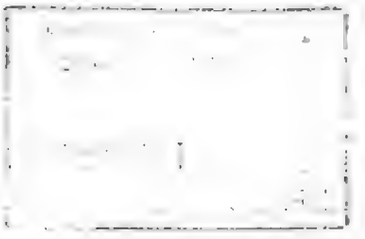

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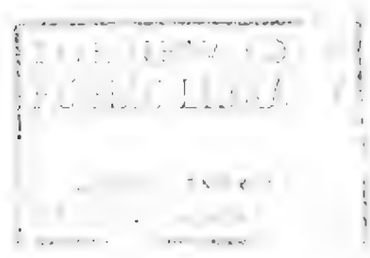

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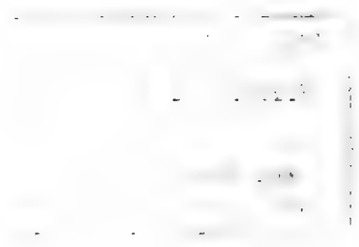

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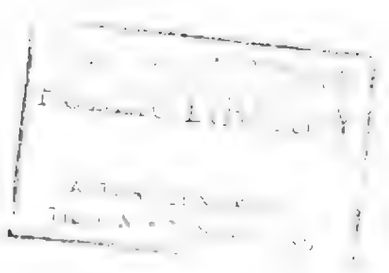

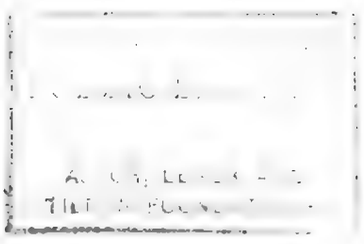

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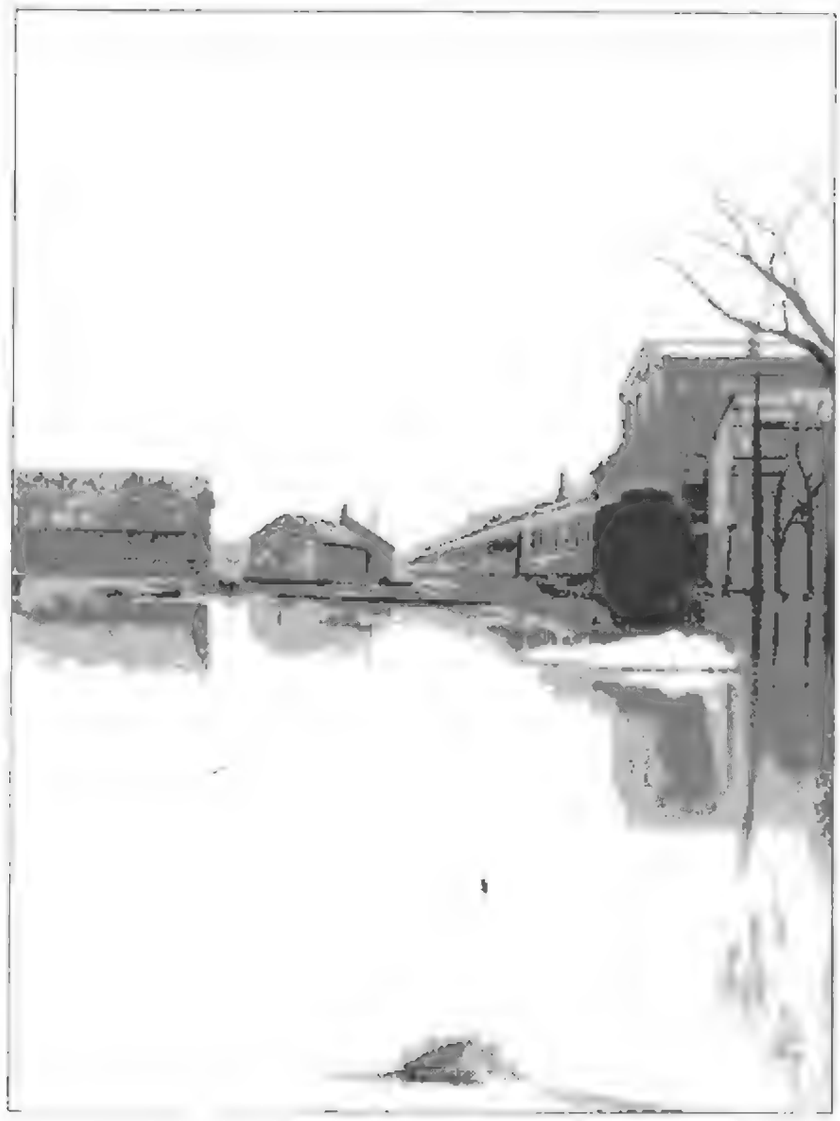

CASTLETON, No. 6. Freshet, 1902.

Looking north from South street on the tracks of the N. Y. C. & H. R. R. R., showing train No. 19 — The Lake Shore Limited.
Water in J. Seaman's coal shed on left 6 feet deep.
Water on railroad track, 28 inches deep.

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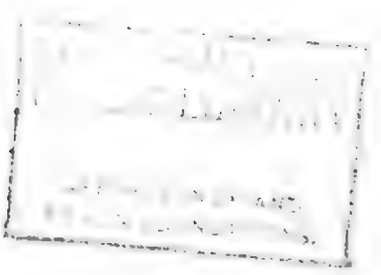

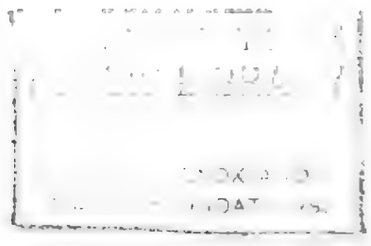

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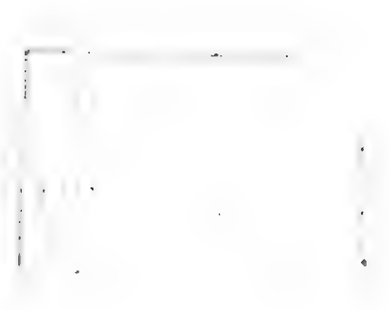

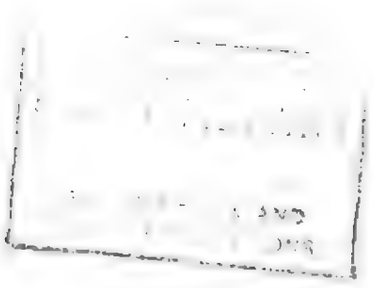

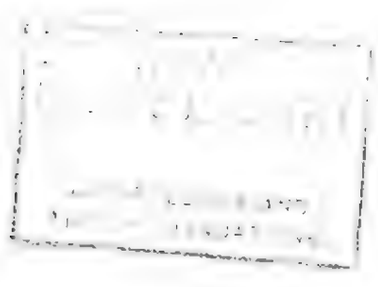

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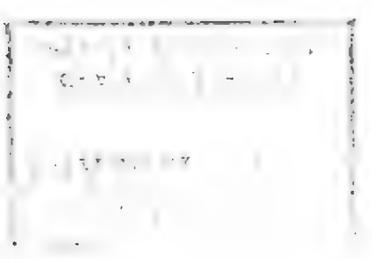

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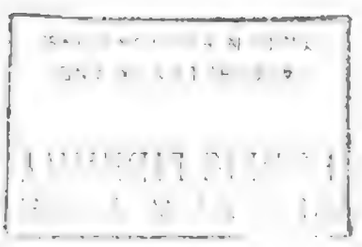

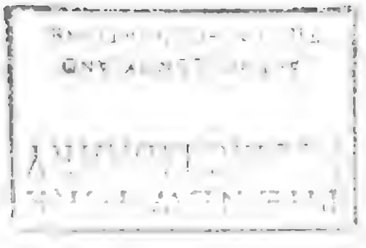

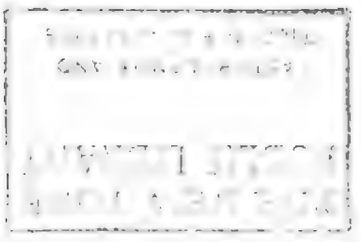

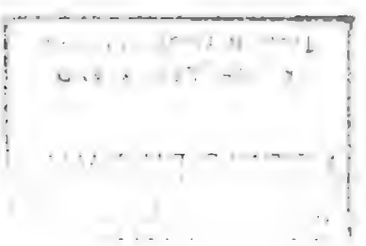

REPORT ON THE HUDSON RIVER

ARRANGED BY THE

Albany Chamber of Commerce

FROM

EXTRACTS FROM REPORTS MADE BY GEORGE W. RAFTER, REGARDING WATER STORAGE ON THE HUDSON RIVER AND ITS TRIBUTARIES; IMPROVEMENTS TO THE HUDSON RIVER; AND THE WATERSHED OF THE HUDSON RIVER AND ITS TRIBUTARIES.

Extended studies have been made of the possibilities of water storage on Hudson river, where the water power has increased from less than 13,000 horsepower in 1882 to something like 55,000 horsepower at the beginning of 1898. The studies, so far as carried, show that it is possible to create on that stream a continuous, permanent power of about 175,000 horsepower. Probably when the studies are complete it will appear that considerably more than this can be developed at a cost which will be commercially feasible.

The southern streams, which all belong to the Hudson system, are Sacandaga, Indian, Cedar, Opalescent, Boreas and Schroon rivers and East Canada and West Canada creeks. All these streams head in lakes.

Following are the principal lakes of the Adirondack Plateau tributary to the Hudson system: Pleasant, Piseco, Oxbow, Sacandaga, Elm, Morehouse, Honnedaga, West Canada, Wilmurt, Salmon, Spruce, Cedar, Lewey, Indian, Rock, Chain, Catlin, Rich, Harris, Newcomb, Thirteenth, Henderson, Sanford, Colden, Boreas, Elk, Paradox, Brant, Schroon, and Luzerne.

HUDSON RIVER SYSTEM.

Hudson river, with its principal tributary, the Mohawk, is the most important river of the State. From its mouth to Troy, a distance of over 150 miles, it is a great inland estuary subject to tidal action, and because of its great length and the large fresh-water inflow it is unique among inland estuaries. From the first landing of the Dutch on Manhattan Island to the present time it has been an important channel of commerce. On his voyage of discovery in 1609, Hendrik Hudson ascended to the head of tidewater, and doubtless discerned the possibilities of future settlement which were so soon realized at Albany, Waterford and Schenectady. The tidal action of Hudson river originally terminated at the rapids above Troy, but its present termination is a few miles below, at the Troy dam, a structure erected about 1820 as a part of the State canal system. There is a lock at the east end of this dam through which canal boats pass into the pool above, thus enabling them to reach Lansingburgh on the east side of the river, or Waterford on the west side, where they may enter Champlain canal.

The following are the elevations of mean tide, mean low tide, and mean high tide, above mean sea level at New York, and the mean rise and fall of tides at various points along the tidal estuary between New York bay and the Troy dam:

MEAN TIDAL ELEVATIONS IN FEET AT VARIOUS POINTS BETWEEN NEW YORK AND TROY DAM.

LOCALITY.	Mean tide.	Mean low tide.	Mean high tide.	Mean rise and fall.
Sandy Hook	....	....	....	4.70
Governors Island	0.00	2.20	2.20	4.40
Dobbs Ferry	0.18	1.62	1.98	3.60
Coxsackie light-house	1.68	0.17	3.53	3.70
New Baltimore	1.73	0.02	3.44	3.42
Coeymans	1.88	0.44	3.31	2.87
Castleton	2.09	0.82	3.35	2.53
Van Wies	2.13	0.82	3.29	2.33
Albany	2.43	1.27	3.59	2.32
Nail works	2.78	1.81	3.75	1.94
Troy dam	3.77	3.37	4.17	0.80

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The most important tributaries begin above Troy. Ascending on the west side we find the Mohawk river, the outlet of Saratoga lake, Sacandaga river, Stony and North creeks, and Indian and Cedar rivers. On the east side there are Hoosic, Battenkill, Schroon and Boreas rivers. Above the mouth of Cedar river the main North or Hudson river is considered to extend to and beyond Lake Sanford, including Opalescent river and the streams issuing from the high Adirondacks.

The following gives the height above tide water at New York of a number of points on Hudson river.

Height Above Tide Water at New York of Points on Hudson River.

	Feet.
New York (at mouth)	0.0
Troy	3.8
Saratoga dam (crest)	102.0
Fort Edward (below dam)	118.0
Glens Falls (crest of feeder dam)	284.0
Mouth of Sacandaga river	556.0
Mouth of Stony creek	584.0
Mouth of Schroon river	608.0
At Glen bridge	728.0
At Riverside bridge	875.0
At North Creek bridge	998.0
At North river	1,050.0
Mouth of Boreas river	1,140.0
Mouth of Indian river	1,415.0
Mouth of Cedar river	1,460.0
Lake Sanford	1,723.0

MOHAWK RIVER.

The Mohawk river, the most important tributary of the Hudson, rises in the western central part of the State, near the Lewis and Oneida county line. It flows in a southerly direction to the city of Rome, from which it takes an easterly course across the State,

emptying into the Hudson a little above Troy. The principal tributaries are Schoharie, East Canada, West Canada, and Oriskany creeks.

The following are the elevations above the tide water of a number of points along the Mohawk river:

ELEVATIONS OF POINTS ALONG MOHAWK RIVER.

	Feet.
At mouth	12
Lower Mohawk Aqueduct	162
Schenectady	214
Mouth of Schoharie creek	270
At Rome, above feeder dam	431

There are two principal Falls of Mohawk river, the Great Falls at Cohoes and the Little Falls at the city of the same name.

The following are the principal subdivisions of the drainage areas of Mohawk river:

SUBDIVISIONS OF DRAINAGE AREA OF MOHAWK RIVER.

	Sq. miles.
At mouth	3,400
Below mouth of Schoharie creek	3,100
At Little Falls	1,275
At Utica	524
At Rome	184

SCHOHARIE CREEK.

Schoharie creek rises in the southern part of Greene county, whence it flows 18 miles northwesterly and then northerly about 50 miles to the Mohawk. The principal subdivisions of the drainage area are as follows:

SUBDIVISIONS OF DRAINAGE AREA OF SCHOHARIE CREEK.

	Sq. miles.
At mouth	947
Central Bridge	684
Gilboa	308

The drainage area of Schoharie creek comprises the greater part of Schoharie county and portions of Greene, Albany, Delaware, Otsego, Montgomery, and Schenectady counties. Its head waters drain the western and northern slopes of the Catskill Mountains. At Central Bridge, about 19 miles from the mouth of the creek, the water surface is 560 feet above tide water; at the mouth the elevation is 274 feet.

EAST CANADA CREEK.

The second important tributary of the Mohawk is East Canada creek, which rises in the southwestern part of Hamilton county and flows southerly, joining the Mohawk at East creek, about 7 miles from Little Falls. According to a map furnished by Stephen E. Babcock, of Little Falls, the total drainage area of East Canada creek is 285.7 square miles, of which 58.2 square miles are in Hamilton county, 98.4 square miles in Herkimer county, 128 square miles in Fulton county, and 1.1 square miles in Montgomery county. Following are the elevations of principal points on East Canada creek:

ELEVATIONS OF PRINCIPAL POINTS ON EAST CANADA CREEK.

	Feet.
Bottom of Beardslee Falls near mouth	0
Top of Beardslee Falls	105
Bottom of High Falls	327
Top of High Falls	379
Crest of dam at Dolgeville	445
Mouth of Spruce creek	447
Mouth of Fish creek	559
Emmonsburg	646
Stratford	720
Oregon	1,140

The distance from the mouth of the stream to Oregon is about 25 miles.

The principal tributary of East Canada creek is Fish creek, which is the outlet of the East Canada lakes. The distance from its point of junction with East Canada creek to the mouth of the Canada lake outlet is about 9 miles, and the total rise in this distance 635 feet. The outlet of the lakes, which is nearly level, is about 3.5 miles long. There are no falls of any magnitude on this creek. For the first 5 miles from its mouth Fish creek rises 245 feet, and from that point to the mouth of the outlet of the East Canada lakes, a distance of 4 miles, the rise is 390 feet.

The second tributary of East Canada creek is Spruce creek, which has a total length from it mouth to its head, in the Eaton Millpond, of about 8.7 miles, the total rise in this distance being about 550 feet. Just below the Eaton Millpond there is a fall of 180 feet in 2,000 feet. At Salisbury center, Spruce creek falls 85 feet in about 900 feet.

WEST CANADA CREEK.

West Canada creek, the third important tributary of the Mohawk, rises near the center of Hamilton county and flows southwesterly about 40 miles, by general course, to the eastern edge of the town of Trenton, in Oneida county, where it turns and first runs southeasterly and then southerly for a total distance of 20 miles, finally emptying into the Mohawk at the village of Herkimer. The total drainage area above Herkimer is given as 548 square miles. This creek has its source in the Canada lakes, which are about 40 miles northeast from the village of Prospect. These lakes are known separately as the West, Middle, and East Canada. The principal lake of this series has an elevation of 2,348 feet above tide water. The drainage area at the village of Prospect, where there is a natural fall of about 22 feet, is 375 square miles. At Trenton Falls, 3 miles below, the stream descends about 200 feet in half a mile. Ascending the stream, the principal falls, in order, are: Sherman falls, 24 feet; High falls, 105 feet; Mill Dam falls, 14 feet; Suydam falls, 12 feet.

According to a report made by Wallace C. Johnson, under date March 17, 1896, to the Trenton Falls Power Company, it appears that of the 375 square miles of drainage area above Prospect

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about 175 square miles lie at an elevation of between 2,000 and 3,000 feet above tide water, the average elevation of this portion being about 2,500 feet. Of the remaining 200 square miles above Prospect the average elevation is placed at not less than 1,600 feet.

OTHER TRIBUTARIES OF MOHAWK RIVER.

As less important tributaries of the Mohawk, Sauquoit and Oriskany creeks may be mentioned. Sauquoit creek rises in the southeastern part of Oneida county and runs northerly, emptying into the Mohawk about two miles west of Utica. Its drainage area is given as 62 square miles. Oriskany creek rises in the eastern-southerly portion of Madison county and flows northerly into the Mohawk 6 miles west of Utica. Its drainage area is given as 135 square miles. There is considerable water power developed on both Sauquoit and Oriskany creeks.

HOOSIC RIVER.

The most important tributary of the Hudson from the east is Hoosic river, which rises in the mountains of Berkshire county, Massachusetts. It first runs northwesterly, passing from Massachusetts into the extreme southwestern corner of Vermont and thence into Rensselaer county, in New York. At the northern boundary of Rensselaer county it turns and pursues a westerly course to the Hudson opposite the village of Stillwater. Its drainage area at the mouth is taken at 730 square miles. Its principal tributaries are Little Hoosic river, Walloomsac river, and Tomhannock creek.

The county drained is mainly mountainous, the summits attaining an elevation of from 1,000 to 2,000 feet above tide water.

Hoosic river is of considerable interest to persons concerned in water power development on the Hudson, below its mouth, because there are two reservoirs on its headwaters which have been constructed by manufacturers in Massachusetts in order to maintain a more equable summer flow. The first of these is the Clarksburg reservoir, on the north branch of Hoosic river, and at a distance of about 2½ miles above North Adams. The second reservoir is on the south branch and is known as the Cheshire

reservoir, being situated in the town of that name. The Clarksburg reservoir is stated to flow 156 acres and to have a depth of 22 feet. The Cheshire reservoir flows about 650 acres and can be drawn down about 8 feet. Both these reservoirs are controlled by an association of mill owners on the Hoosic and its branches in the State of Massachusetts.

BATTENKILL RIVER.

Battenkill river, another important tributary of the Hudson, rises in the southwestern part of Vermont, in Bennington county. It first flows southwesterly and then westerly irregularly across Washington county, New York, to the Hudson at a point about a mile above Schuylerville. The drainage area is taken at 460 square miles. The elevation above tide at the mouth of the river is 82 feet, and at the Delaware and Hudson Railway crossing, a little south of Shushan, the elevation is 437 feet. This gives a descent of 355 feet in 22 miles, about one-half of which is concentrated within the last 4 or 5 miles of the river's course.

FISH CREEK.

Fish creek, a stream tributary to the Hudson at Schuylerville, is the outlet of Saratoga lake. Its chief tributary is the Kayaderosseras creek, which drains the central part of Saratoga county. The drainage area of Fish creek at its junction with the Hudson is estimated at 253 square miles.

SACANDAGA RIVER.

Sacandaga river is the next important tributary of the Hudson in the ascending order. It has three principal branches, which unite to form the main river in the southeastern part of Hamilton county. The west branch is the outlet of Piseco lake; the middle branch is the outlet of Sacandaga and Pleasant lakes, while the east branch issues from a series of small ponds and lakes in the southwestern part of Warren county, not far from Bakers Mills. The east and middle branches unite a few miles to the north of Wellstown, and west branch joins a few miles south of

Wellstown. Ths river then flows southeasterly to about 5 miles below Northville, where it turns rather more than a right angle and flows irregularly northeast to the main Hudson at Hadley. The principal tributary of the Sacandaga, aside from its branches, is East Stony creek.

The following are the several subdivisions of the drainage area of Sacandaga river:

SUBDIVISIONS OF THE DRAINAGE AREA OF SACANDAGA RIVER.

	Sq. Miles
Total drainage area at mouth	1,040
South branch	240
Middle branch	115
East branch	124
Stony creek	212
Main river below Stony creek	223

The following are elevations above tide at a number of principal points:

ELEVATIONS ABOVE TIDE OF POINTS ALONG SACANDAGA RIVER.

	Feet.
At mouth of river	556
Above dam at Conkinville	697
Northville	732
Hope Center	763
Wellstown	902
East branch at old tannery	958
East branch at foot of High falls	1,205
East branch at head of High falls	1,337
East branch at Brighams pond	1,706
Piseco lake	1,648
Lake Pleasant	1,706
Sacandaga lake	1,706

From Conklinville to the mouth of the river, a distance of a little over 5 miles, the river falls 141 feet.

SCHROON RIVER.

Schroon river rises in Essex county, along the southern slopes of the highest mountains of the Adirondack group. It flows in a general southerly direction for about 45 miles, through Essex and Warren counties, and joins the Hudson just above Thurman. On the boundary between Essex and Warren counties the river flows through Schroon lake, a body of water nearly 9 miles long and from a little less than 0.5 to 1.5 miles in width.

The following are some of the important subdivisions of the drainage area of Schroon river.

SUBDIVISIONS OF THE DRAINAGE AREA OF SCHROON RIVER.

	Sq. Miles
At mouth	550
Warrensburg	535
Tumblehead falls	502
Foot of Schroon lake	479

Some of the elevations on Schroon river are as follows:

ELEVATIONS ON SCHROON RIVER.

	Feet.
At mouth	610
Schroon lake	807
Paradox lake	820
Schroon falls	840
Elk lake	1,986

There is no developed water power on Schroon river except that at Warrensburg.

LOW-WATER FLOW OF MOHAWK RIVER.

The drainage area of this stream is 3,400 square miles. According to David H. Van Auken, the engineer of the Cohoes Company, at Cohoes, the minimum flow of Mohawk river does not exceed 800 cubic feet per second, or 0.235 cubic foot per square

mile per second. Since considerable water is taken from Mohawk river for the supply of Erie canal probably Mr. Van Auken's statement relates to the amount realized for water power at Cohoes, and, in the absence of definite figures as to the amount abstracted for the canal, must be taken as somewhat general. There is, however, a well-defined feeling that the minimum flow of the Mohawk has been gradually decreasing during the last twenty or twenty-five years, due probably to decreasing deforestation of the drainage area.

LOW-WATER FLOW OF HUDSON RIVER.

The drainage area above Mechanicville is 4,500 square miles. The natural flow of this stream is somewhat obscured by the presence of a considerable number of lumbermen's reservoirs on its head waters, the total storage of which aggregates about 4,000,000,000 cubic feet. The month of minimum run-off for the whole period covered by the measurements was July, 1888, the mean for the month being 1,537 cubic feet per second, or 0.39 inch on the watershed. For short periods the mean flow has been less than this. Thus, from August 14 to 19, 1890, the mean flow was 1,080 cubic feet per second; also from October 2 to 6, 1891, inclusive, the mean flow drainage area this gives 0.24 cubic feet per second. For 4,500 square miles drainage area this gives 0.24 cubic foot per second. Taking the diversion for the supply of Champlain canal into account, we have about 0.29 cubic foot per square mile per second as the actually observed minimum flow.

The figures show, moreover, that the minimum of 0.29 of a cubic foot per second has occurred for only two periods, one of six days and the other of five days, a total of eleven days for the whole period covered by the measurements. For July, 1888, the mean flow, including the diversion which was then occurring for the supply of Champlain canal may be taken at 0.37 of a cubic foot per square mile per second. For October, 1891, the mean flow for the whole month was 1,427 cubic feet per second, or, including the diversion to the Champlain canal, 0.36 of a cubic foot per

square mile per second. In July, 1890, the mean flow for the month was 1,950 cubic feet per second, and in several other months, as July, 1893, July, 1895, and September and October, 1895, the mean monthly flow varied from about 2,600 to 2,700 cubic feet per second.

EARLY SURVEYS.

The project for constructing storage reservoirs on the upper Hudson has been agitated for many years, the first surveys for this purpose having been made in 1874. In that year Prof. F. N. Benedict conducted surveys, and in his report proposed an extensive system of reservoirs. The chief interest attaching to this report is the proposition on the part of Mr. Benedict to build storage reservoirs at Blue Mountain, Racket, Forked, Beach, and Long lakes, and divert the water stored on these several lakes from their natural drainage into Racket river, to the south, thus making them artificially tributary to Hudson river. In proposing this diversion, Mr. Benedict apparently assumed that the State, in its sovereign capacity, could divert waters from one drainage basin to another without regard to the rights or wishes of the riparian owners.

In addition to the lakes already enumerated, which are naturally tributary to Racket river, Mr. Benedict proposed to make reservoirs of the following lakes and ponds in the upper Hudson drainage area: Round pond, Catlin lake, Rich lake, Harris lake, Lake Henderson, Newcomb lake, Lower Works reservoir, Chain lakes, Goodenow pond, Goodenow river reservoir, South pond, Clear pond, Slim pond, Ackerman pond, Perch pond, Trout pond, Lake Harkness, Shedd lake, First Sergeant pond, Third Sergeant pond, Plumley pond, Moose pond, and Cary pond. The total storage to be furnished by the entire system of reservoirs is placed at 18,419,781,600 cubic feet. The total cost of the proposed reservoirs was placed by Mr. Benedict at about $265,000, or, including the diversion canal and improvements at Long lake, at a total of about $460,000. The dams proposed were to be constructed of timber, very much after the plan of the timber dams still constructed by the lumbermen in this region.

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RESERVOIR SITES ON SACANDAGA, MAIN HUDSON, AND SCHROON RIVERS.

The surveys, so far as carried, indicate that economical reservoirs controlling the entire drainage area to full capacity in the year of minimum rainfall may be constructed in the Sacandaga, main Hudson, and Schroon valleys, as shown in the following paragraphs.

The Sacandaga river has, as already stated, a total drainage area above its mouth at Hadley of 1,040 squre miles. The catchment areas of reservoir sites on Sacandaga river, in square miles are as follows:

CATCHMENT AREAS OF RESERVOIR SITES ON SACANDAGA RIVER.

	Sq. Miles.
Lakes Pleasant and Sacandaga	45
Piseco lake	55
Arietta flow	40
Miscellaneous	50
Total	190

The main Hudson or North river has a total drainage area above Hadley, not including Schroon river, of 1,092 square miles. Of this area the portions shown below may be developed to full capacity in the year of minimum rainfall:

CATCHMENT AREA OF RESERVOIR SITES ON MAIN HUDSON RIVER.

	Sq. Miles.
Thirteenth pond	14
Chain lakes	58
Catlin lake	25
Lakes Rich, Harris, and Newcomb, and the Goodenow flow	83
Lake Henderson	18
Lake Sanford and the Tahawus flow	67
Boreas river and Boreas pond	45
Cedar river	58
Indian lake	146
Total	514

Schroon river has a total drainage area above its mouth of 550 square miles. The topography of the Schroon area is such as to admit of two distinct lines of treatment — either to construct one large dam at Tumblehead falls, about a mile below South Horicon, or to construct a series of 16 to 18 small dams at various points in the area. In either case it is possible to control substantially the full flow of the 502 square miles above Tumblehead falls, and the decision of which is better will turn chiefly on the question of relative cost, the estimate taking into account the fact that it will cost much more to operate a large number of reservoirs than to operate one.

CATCHMENT AREA OF SMALL RESERVOIRS ON SCHROON RIVER.

	Sq. Miles.
Minerva brook at Olmsteadville	43.4
Hewett pond	2.5
Loon lake	11.6
Friend lake	4.9
Elk lake	15.9
Clear pond	2.3
New pond	1.7
Deadwater pond	18.9
Hammond pond	11.4
Dudley pond	3.9
Overshot pond	4.9
Paradox lake	31.6
Paragon lake	7.6
Crane pond	7.2
Pharaoh lake	8.3
Brant lake	38.7
Valentine pond	6.7
Schroon lake at Starbuckville	259.2
Total	478.7

The area between Starbuckville and Tumblehead falls not available with the system of small reservoirs is 23.3 square miles.

The total controllable area of the upper Hudson, with the system of small reservoirs in the Schroon Valley, is as follows:

TOTAL CATCHMENT AREA OF UPPER HUDSON RIVER.

	Sq. Miles.
Sacundaga Valley	190
Hudson above Hadley	514
Schroon Valley	479
Total	1,183

With one large reservoir in Schroon Valley the catchment area is increased to 1,206 square miles.

The system of small reservoirs outlined in the foregoing is estimated to store 15,330,000 cubic feet, at a cost of $1,172,500; hence the cost per million cubic feet stored becomes $76.48. These figures, however, do not take into account the annual cost of maintenance and operation, which may be placed at $30,000 per year, and capitalized at 5 per cent. is equivalent to a permanent investment of $600,000. Adding $600,000 to $1,172,500 gives a total permanent investment of $1,772,500.

A general estimate of the cost of the single large reservoir in Schroon Valley shows that with a dam at Tumblehead falls, 59 feet in height, there would be impounded 15,925,000,000 cubic feet. The preliminary estimate indicates a total cost of $840,000, and a later survey indicates about $1,000,000. The final revision of the estimate on completion of the investigation may show a somewhat larger figure than this. Even if the cost were to be $1,000,000, it would still be exceedingly cheap storage, the cost for 15,925,000,000 cubic feet being on this basis only $69.14 per million cubic feet stored.

The dam at Tumblehead falls would be located just below the outlet of Brant lake, the elevation of the water surface of which is 801 feet. The flow line of the proposed reservoir has been placed at an elevation of 840 feet, thus giving a depth of 39 feet over the surface of Brant lake, a depth of 33 feet over the surface of Schroon lake and a depth of 20 feet over Paradox lake. With

the reservoir full or nearly full, there would be continuous navigation from the head of Brant lake to the head of Paradox lake of about 35 miles. The villages of South Horicon, Bartonville, Starbuckville, and parts of Pottersville and Chester are within the flow of this reservoir.

As another large reservoir to be built on the head waters of the Hudson, Indian lake reservoir may be mentioned. The total controllable area of this lake is 140 square miles which is capable of furnishing in the year of minimum run-off 4,468,000,000 cubic feet. To provide this storage, a dam, raising the water surface 23 feet above the present dam, is required. The storage of the present dam, 10 feet in height, is estimated at 800,000,000 cubic feet.

Piseco lake may also be referred to as another large reservoir which may be constructed on the upper Hudson at low cost. It is estimated that a storage of 1,725,000,000 cubic feet may be made, at an expenditure of $70,000, or at an average cost per million cubic feet stored of $40.

Without going further into detail, the following may be given as the approximate storage of the entire upper Hudson system, worked out to date.

APPROXIMATE STORAGE OF UPPER HUDSON RIVER.

	Cu. Feet.
Storage of Sacandaga and main Hudson river drainage areas, not including Boreas river reservoir, Boreas pond, Indian lake and Piseco lake	14,364,000,000
Boreas river reservoir and Boreas pond	1,111,000,000
Indian lake	4,468,000,000
Piseco lake	1,725,000,000
Schroon Valley	15,925,000,000
Hadley	4,000,000,000
Conklinville	4,000,000,000
Total	45,593,000,000

This storage is considered sufficient, in conjunction with the natural flow of the unregulated portion of the river, to maintain at Mechanicville a flow of at least 4,500 cubic feet per second during the entire year.

In addition to the reservoirs named above, the general investigations indicate that there is, possibly, an opportunity to make a large reservoir on Sacundaga river by the erection of a dam about 20 feet in height at Conklinville, where there is a reach of river extending 24 miles to Northville. The available storage of such a reservoir is taken at about 4,000,000,000 cubic feet.

There is also an opportunity to construct on the main Hudson at Hadley, just above the mouth of the Sacundaga, another reservoir of about 4,000,000,000 cubic feet capacity, at a point where the natural conditions for constructing such a reservoir are considered very good. At the cite of the proposed dam the river shows a granite rock bottom with precipitious banks nearly 40 feet in height and about 100 feet apart. The material for a permanent stone dam exists in the vicinity, with an opportunity to construct a wasteway over natural rock at one side.

Inasmuch as all the storage, except that of the Sacundaga area, would pass through the Hadley reservoir, its construction would simplify the management of the system very greatly. In the summer season, as long as there is any storage above to be drawn upon, this reservoir could be kept nearly full and just the right quantity drawn out from day to day to keep the river at the assumed flow of 4,500 cubic feet a second at Mechanicville.

EFFECT OF PROPOSED STORAGE ON RIVER FLOW.

The foregoing quantities of storage have been fixed upon on the basis that the water yield of the year of minimum stream flow will furnish a storage of at least 12 inches, the flow line of the reservoirs themselves being located with reference to holding back 13.5 inches.

In conclusion, it may be said that it is entirely feasible to construct a system of reservoirs in the upper Hudson Valley, and such system may be designed with reference to the full capacity

storage of at least 1,300 square miles of area, or 47 per cent. of the total area above Glens Falls. Such control would result in the material reduction of floods at Glens Falls and other points.

The proposed total storage of 45,593,000,000 cubic feet would maintain 4,500 cubic feet per second flow, as well as supply the other necessary demands, in the driest season of the gauging period.

The discharge measurements show that whereas the minimum unregulated flow at Glens Falls is as low as 900 cubic feet per second for a monthly mean with the storage carried out, the probable monthly mean flow at Glens Falls will be at least 3,000 to 3,600 cubic feet per second. The minimum regulated flow of 4,500 cubic feet per second at Mechanicville will increase the low-water depth in Hudson river at Albany about 1.5 feet.

The diversion of water for the use of Champlain canal is an injury to the water power at Glens Falls and lower points on the river. Since water power is much cheaper than steam power, the taking of the water of the river away from the manufacturers is a serious matter. In the fourteen years, from 1882 to 1895, the use of water power on Hudson river has increased from a total of 12,894 net horsepower in 1882 to 43,481 net horsepower in 1895, an increase of 237 per cent.

The upper Hudson storage system is estimated to cost from $60 to $70 per million cubic feet stored, a sum considerably less than the cost of many other systems.

The Hudson river naturally divides into two sections, the upper and the lower, at the Troy dam, which is now the head of the lower tidal section, although before the erection of the dam it is probable that the tidal influence was felt as far up as Waterford.

The drainage area at Troy, as estimated from the State maps, is taken at 8,000 square miles; at Mechanicville, at 4,500 square miles, and at Glens Falls, at 2,800 square miles. The Mohawk river, the longest tributary of the Hudson, has a drainage area of about 3,400 square miles. The next longest tributary below

Glens Falls is the Hoosic, with a drainage area of 460 square miles.

Above Glens Falls the first tributary of importance is the Sacundaga, which joins the main river at Hadley. Its drainage area is 1,040 square miles.

At Thurman we have the Schroon, with an area of 550 square miles.

A considerable portion of the drainage area of the Hudson above Mechanicville lies in the States of Massachusetts and Vermont.

IMPROVEMENT OF NAVIGATION IN THE HUDSON RIVER.

Between New Baltimore and Troy.

This part of our subject has been so thoroughly discussed in the various reports of the United States government engineers, and also in several of the annual reports of the State Engineer and Surveyor, that I shall go no farther here than to indicate the lines on which the improvement now in process has been carried out, and the probable effect on the river of such increase of the dry weather flow as may be expected to result from the construction of the proposed system of reservoirs.

From a few miles below New Baltimore there has never been until recently any trouble on account of lack of water for navigation purposes; the work of improvement has therefore been mostly confined to that section of the river extending from New Baltimore to Troy, a distance of about twenty miles. This work has been carried on more or less continuously since 1797, in which year the first State appropriation was made. Before 1831 the work was carried on under State appropriation and contributions from the cities of Albany and Troy, but in that year the jurisdiction of the federal government over these waters was confirmed by judicial decision.

Since 1831 the work has been carried on by both the State and federal governments. The last State appropriation was in 1892.

Previous to 1866 the work was of somewhat unsatisfactory character, owing to its being largely without any comprehensive plan of operation, as well as irregularly. Some increase in depth of channel was, however, effected as may be gathered from the statements of depth at several points following.

The plan of improvement followed since 1867 was devised by General Newton on the principle that, in a tidal estuary receiv-

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ing a moderate inflow of fresh water at its head, an increased depth of water is best secured by increasing the tidal scour.

According to General Newton, in his annual report to the chief of engineers for 1875, the action of the flood tide is to form deposits of whatever detritus may be carried in suspension, while the ebb tides tend to scour such deposits away. Under such action the inclination of the bed of a stream increases toward the head until the two forces are in equilibrium; when this point is reached the slope of the bed and the depths become constant.

The erection of the Troy dam has had the same effect in decreasing the scour of the ebb as would result from natural causes somewhat higher up if the dam had not been built, or, if the present position, with the result of an increase in the scouring action of the ebb in front of the city of Troy. It may be concluded, then, that the location of the Troy dam below the head of original tidal influence is in some degree responsible for the difficulty in maintaining a channel between Albany and Troy.

General Newton's plan, as adopted in 1867, provided for securing a navigable channel eleven feet deep at mean low water from New Baltimore to Albany, and nine feet deep at mean low water from Albany to Troy. This work has been carried out along the following lines:

(1) A system of longitudinal dikes to confine the current sufficiently to allow the ebb and flow of the tidal current to keep the channel clear. These dikes to be gradually brought nearer together from New Baltimore towards Troy, so as to assist the entrance of the flood current and increase its height, their height to be kept approximately at the level of the tidal high water, so as not to confine the freshets, the exact level, however, being left to be determined as the work progresses.

(2) That the dredge be used as far as necessary to open the channels above described, which the current should not be allowed to do, except very gradually, lest accumulations dangerous to navigation be formed below.

(3) Keeping, as far as practicable, the side reservoirs open to the passage of tidal currents by gaps at their lower extremities in order to increase the tidal flow.

(4) Dumping all dredged material in secure places, where it cannot be moved back again into the channel by the current.

(5) Constructing the dikes of timber and stone in a manner to secure their permanancy at a minimum cost, the details, varying with the locality, to be left to the discretion of the local engineer, to be so designed as to admit of having an increased height given to the dikes if necessary.

(6) To protect, when necessary, the banks and islands against the abraiding action of the currents by revetments.

(7) That limits, beyond which no encroachment upon the channel should be made, be prescribed, and that any such encroachments be reported to the engineer in charge.

This improvement was substantially completed on June 30, 1892, the total expenditure thereon by the federal government amounting to $1,247,940.29.

July 13, 1898, Congress sanctioned another project, which provides for maintaining all improvements and constructing new regulating works for eight miles below New Baltimore, and also deepening the entire reach so as to afford a channel 400 feet wide and twelve feet deep, from Coxsackie to the foot of Broadway, Troy, and from thence 300 feet wide and 12 feet deep to the State dam. A sum not to exceed $2,447,906, in the aggregate, was appropriated for this work.

From 1797 to 1892, inclusive, the State of New York appropriated for work on the Hudson river the sum of $1,504,429.29. Between 1825 and 1867 the city of Troy contributed $127,248.59, and the city of Albany $5,566.66, a total contribution for the two cities of $132,815.25. The total amount expended and appropriated for Hudson river improvement from 1797 to date is therefore, $5,333,090.83.

The results obtained by this expenditure are exhibited by the following:

In 1819 the available channel depth between New Baltimore and Albany was four feet at low water; in 1867 it had increased to 7.5 feet; in 1879 to 8.5 feet; in 1885 to 10 feet, and in 1892, to nearly 11 feet.

Early in the present century the tidal rise in this section of the Hudson river was 1.2 feet at Troy; 2.3 feet at Albany, and 3.7 feet at New Baltimore. At the present time the tidal observations show, at the Troy dam 0.8 feet, at the steel works 2 feet, at Albany 2.5 feet, at Castleton 2.6 feet, at Coeymans 3 feet, and at New Baltimore 3.4 feet.

The main rise in New York harbor is 4.4 feet.

The plane of mean low water at New York is below that at Troy dam, 4.1 feet, below that of the steel works 2.5 feet, below Albany 2 feet, Castleton 1.6 feet, and below New Baltimore 0.8 feet.

In the same way the plane of mean high water at New York is above that of the Troy dam 0.52 feet, the steel works 0.12 feet, Albany 0.06 feet, Castleton 0.25 feet, and New Baltimore 0.17 feet.

Comparing these figures as to tidal planes at the several points and it is at once apparent that the surface slope of the stream is considerably less in the regulated section at time of high water than at low water.

For instance, the fall from Troy dam to New Baltimore at low water is 3.3 feet, while at high water as a mean is 0.7 feet. Further, this is not uniformly distributed, as we see that between Albany and New Baltimore the high water surface slope is only 0.11 feet; between Albany and the steel works it is also only 0.18 feet, leaving 0.14 feet between the steel works and the Troy dam.

It is clear then, that the movement of the ebb flow in the channel must at the beginning be very slow and any practicable method of increasing the high water slope is worthy of very serious consideration. But before examining that phase of the question let us consider the theory of the present improvement one step farther.

In arriving at the plan of systematic improvement carried out since 1867, it was assumed that the minimum fresh water flow of the Hudson river was as low as about 2,000 cubic feet per second for a considerable portion of each year. On this point the eight-year gaugings, which we have tabulated and diagramed, furnish definite information which was not available in 1867, and which, of course, could not be available until after the lapse of the several years required to make such a series. It is insufficient to say then that the gaugings established the fact that usually the summer flow at Troy is considerably greater than 2,000 cubic feet per second. Indeed, it will be only in an extreme case that it runs as low as that for short periods.

The gaugings also show that freshets of from 80,000 to 100,000 cubic feet per second may be expected. While such flows continue they give ample volume and velocity for scouring away deposits in the head of the river which have been made in previous periods of low water. Their good office in this particular is, however, more than balanced by their tendency to wear away the banks and islands, transporting sand, gravel and mud to form obstructions lower down. The floods must therefore be considered as something of a menace to the integrity of the regulating works, however well constructed, for even though the exposed banks and heads of islands are protected by revetments, still the flood flows will inevitably transport from the higher reaches of the river a vast quantity of detritus to be dropped somewhere in the tidal portion. It is fundamentally true, therefore, that river regulation, wherever it is possible to do so, should also proceed on the line of decreasing the flood flows, as means of protecting the tidal portions from the inevitable filling up somewhere which otherwise must certainly occur.

It is not intended in the foregoing discussion to intimate that the plan worked upon since 1867 is not on the whole the best that can be desired for the peculiar circumstances of the Hudson river. On the contrary, it is believed to be in every way suited to the conditions of this river. We merely need to go one step farther. The effect of the dikes already constructed is to confine

the summer flows to a channel much narrower than the original, and which are high enough to permit of considerable increase in the summer flow before the water would rise above them, and overflow into the broad areas at the sides.

An increase in depth may therefore be accomplished by so regulating the flow of the river, by impounding reservoirs, as to give a larger summer fresh water flow than we now have. By this means it is further quite possible to so far modify the floods flows as to materially decrease the amount of detritus and alluvial deposits in the tidal section. The cost, therefore, of maintaining a channel in the future will be materially decreased by such procedure.

It appears then that an artificial increase in the summer fresh water flow of the stream would be a benefit in three particulars: (1) by increasing the depth; (2) by increasing the surface slope of high water, thereby increasing the velocity and consequent scouring action of the ebbflow, and (3) by decreasing the floods and their prejudicial eroding and transporting action.

By courtesy of Col. George L. Gillespie, of the Corps of Engineers, I have been furnished with the daily tide record as kept by the United States Engineers at Albany for the navigation season of 1894 and 1895.

A study of the record shows that whenever the river rose to a flow of from 4,000 to 5,000 cubic feet per second at Mechanicville, there was an increase in the height of both the flood and the ebb tides at Albany of about 1.5 feet. Hence the mean depth of water was increased by that amount. To this proposition there is almost no exception during the two years for which we have the reliable record of tides. It follows then with absolute certainty that such regulation of the flow of the fresh water portion of the stream, by impounding reservoirs, as will insure not less than 4,500 cubic feet per second at Mechanicville will of itself alone under existing arrangements increase the mean depth of water at Albany about 1.5 feet.

In this place it may be pointed out that taking into account the difference in tributary drainage areas we will then have in the

river at Troy where we are below the Mohawk, which by itself has a drainage of 3,400 square miles, an actual ordinary summer flow of nearly 6,000 cubic feet per second.

It will be noticed, too, that the difference in elevation between high and low water is quite as marked when we have 4,500 cubic feet at Mechanicville as when the river is near the minimum stage. Hence with the large increase in volume resulting from the increased inflow the scour must be correspondingly greater at such times, while the larger inflow must further tend to maintain the slope during the entire period of ebb flow.

Moreover, these considerable advantages of increased inflow are gained without in any degree approximating to the limit where destructive flood action begins.

We have then as the approximate cost of the entire system and the storage, the following:

	Storage in cubic feet.	Estimated cost.
Amount as above	14,364,000,000	$1,098,559 00
Boreas and Cheney ponds	1,111,000,000	118,000 00
Indian lake	4,468,000,000	120,000 00
Piseco lake	1,725,000,000	70,000 00
Schroon valley	15,925,000,000	840,000 00
Hadley	4,000,000,000	360,000 00
Total	41,593,000,000	$2,606,559 00

In drawing a series of conclusions from the foregoing discussion it may again be remarked, that by reason of incompleteness of the data some of the conclusions are necessarily tentative, and subject to modification if more extended data should indicate any essential error in the present discussion. In any case, the foregoing is the best the undersigned is capable of doing in the time available and with the material at hand. With this understanding we may say:

(1) It is entirely feasible to construct a system of reservoirs in the upper Hudson Valley.

(2) Said system may be designed with reference to the full capacity storage of at least 1,200 square miles of area.

(3) The total area above Glens Falls is 2,800 square miles, of which 1,200 square miles the area controllable to full capacity is forty-three per cent. Hence such control will result in material reduction of floods at Glens Falls and other points.

(4) For present purposes the total storage may be placed at 41,593,000,000 cubic feet.

(5) The Mechanicville gaugings give us definite information as to the regimen of the stream for eight years.

(6) The proposed total storage of 41,593,000,000 cubic feet would maintain 4,500 cubic feet per second flow, as well as supply the other necessary demands, in the driest season of the eight-year period.

(7) The gaugings show that, whereas the minimum unregulated flow at Glens Falls is as low as 900 cubic feet per second for a monthly mean, with the storage carried out, we may expect at least 3,000 to 3,600 cubic feet per second as the monthly mean flow at Glens Falls.

(8) The minimum regulated flow of 4,500 cubic feet per second at Mechanicville will increase the low-water depth in the Hudson river at Albany about 1.5 feet.

(9) The leakage of the Glens Falls feeder is a great injury to the water power at Glens Falls.

(10) The legitimate diversion for the use of the Champlain canal, both present and prospective, is also an injury to the water power at Glens Falls and lower points on the river.

(11) Water power is much cheaper than steam power; hence the taking of the water of the river away from the manufacturers is to them a serious matter.

(12) In the thirteen years from 1882 to 1895, the use of water power on the Hudson river has increased from a total of 12,894 net horsepower in 1882, to 43,481 net horsepower in 1895, an increase of 237 per cent.

(13) Taking into account the capitalized value of the several benefits to be derived from the upper Hudson storage and we reach the grand total of $38,019,528.

(14) The reservoir system is estimated to cost $2,606,559. This sum includes clearing below the flow line, roads about the reservoirs and the providing of logways and fishways.

(15) The upper Hudson storage system is also estimated to cost $62.69 per million cubic feet stored, which is found to be considerably less than the cost of many other systems.

(16) By clearing all timber below the flow lines and by the construction of roads around the lakes, this reservoir system can be made an attractive feature of the proposed Adirondack park.

(17) The reservoirs will exert a beneficial effect on the fisheries.

(18) Similar reservoir systems carried out on the upper Mississippi river have been of great benefit to navigation and the other interests.

(19) In New England vast benefits to the manufacturing interests have resulted from the construction of storage reservoirs for water power purely.

(20) The State owns the Hudson river, but such ownership carries with it the responsibility of acting in some direction.

For more detailed information consult:

Water Supply and Irrigation papers of the United States Geological Survey, Rafter, 1899.

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Report Regarding Condition of Hudson River and Breaking of Ice Gorge at North Coeymans.

The Committee on Freshets in the Hudson River of the Albany Chamber of Commerce, held a meeting on Tuesday, March 3, 1903, for the purpose of considering the advisability of attempting to remove the ice gorge in the Hudson river below Castleton. At this meeting the conditions existing in the vicinity of this gorge was very carefully considered. These conditions were found to be as follows:

On December 22, 1902, the ice moved out of the Hudson river and two gorges formed, one at the lower end of Cow island, extending across the river to the west bank; the second gorge at Clifford's ice house, extending across the river to Mull's lower beacon.

On December twenty-third there was a twelve-foot freshet in the Hudson river at Albany. After this the weather turned cold and the freshet flow of water into the Hudson practically stopped and the two gorges settled and formed themselves into a solid mass.

On February 28, 1903, the ice moved out of the river above Albany and a small gorge formed at Lagoon island. At this time there was a four-foot freshet in the river at Albany.

On March first the ice in front of Albany moved out, and the gorge at Cow island gave way and the gorge at Clifford's ice house shoved down about 100 feet; as a result of this and a series of new gorges, more compact and dangerous than the first, were formed.

On the afternoon of March first there was a 14.57-foot freshet in Albany, a rise during the twenty-four hours of 10.57 feet; at the same time at Stuyvesant the water in the river was only about a foot above normal.

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The new gorges formed were as follows:

The old gorge at Clifford's ice house shoved down, forming a more compact mass to a distance of about 100 feet south of the ice house and extending directly across the river from shore to shore. Another gorge formed, extending from Roah Hook light directly across the river to the eastern shore. Between this lower gorge and the upper gorge, a third gorge formed, extending from North Coeymans dock diagonally across the river northward to the east shore. Just above this gorge a fourth gorge formed, about opposite the McKnight and Parkinson ice house; this gorge, extending only partly across the river, was composed almost entirely of dirty ice and mud and was piled up above the surface of the river about twenty-five feet. In speaking of these gorges a prominent riverman, who has given the subject careful consideration, said:

"The gorge at Coeymans formed an impassable barrier and was the worst that had formed in the Hudson in years. It is the product of two gorges that had formed between Van Wie's Point and New Baltimore, and the ice had piled cake on cake until the river was spanned from shore to shore by a barrier that reached from the river bed to many feet above the surface of the water. Were it earlier in the winter we might hope that this gradual sweeping through of the water would disintegrate the gorge before a serious flood ensued, but it was so near spring now that the next thing we could expect would be the heavy spring rains, which would cause a bigger freshet than ever."

After considering these conditions the meeting adjourned until Wednesday morning for the purpose of securing an estimate as to the cost of removing the gorges by working at them with boats from the south side.

On Wednesday, March 4, 1903, the committee held its second meeting, and after carefully considering the proposition made the committee by the Cornell Steamboat Company, through Captain Ulster Davis, the following resolution was unanimously adopted:

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"The Committee on Freshets in the Hudson River of the Albany Chamber of Commerce favor the plan of securing the steamers Norwich, George W. Washburn and W. M. Bavier, of the Cornell Steamboat Company, to come from Rondout to the south end of the ice gorge in the Hudson river at North Coeymans, breaking up the ice now in the river between the above points and to endeavor to dislodge the gorge itself."

The committee received an offer from the steamboat company agreeing to do the above work with the three mentioned steamers at a cost of $1,000 per day — at a minimum charge of $2,500.

After careful consideration, the committee considered it advisable to attempt the experiment of removing the ice gorge by the use of boats. If this experiment is successful, it will largely solve the difficult problem now before the committee, and if unsuccessful, it will remove one of the remedies often suggested.

The committee is not willing to undertake this work until the necessary funds are in hand, and parties liable to be affected by a freshet are asked to send at once subscriptions for this work to William Bayard Van Rensselaer, chairman of the committee, at the rooms of the Chamber of Commerce, 95 State street.

Arrangements were at once made by the committee for the collection of the necessary money in order that the steamboats might be set at work immediately. The Cornell Steamboat Company fearing that the sudden rise in the river might make the work of ramming the gorge exceedingly dangerous, decided to start out their steamers without waiting for orders from the committee, and on Thursday morning, March fifth, two steamers left Rondout bound for the ice gorge. These steamers arrived at Athens at noon of the same day. At this time there was about an eleven-foot freshet in the river at Albany, while the water below the gorge was normal, thus showing that the high water at Albany was due entirely to the gorge. Along the entire distance they encountered solid field ice, except at the mouth of the Saugerties and Catskill creeks, where there were open spaces. At six o'clock in the evening the boats tied up at the dock at New Baltimore. Above Athens the steamers en-

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countered very heavy ice, and from New Baltimore to the face of the gorge above Coeymans the ice was in a solid field averaging sixteen inches in thickness. On the morning of Friday, March sixth, the steamers, after working in the vicinity of the gorge for a short time, turned and went down the river as far as Four-Mile Point, in order that they might entirely clear the ice from the narrow channel. This was done in order that there might be no obstructions from below to prevent the ice from floating down the stream. Between Stuyvesant and New Baltimore twelve and fifteen-inch ice was found solid from shore to shore, and the steamers found ice eight feet high on the "drowned lands."

After clearing the river of field ice from New Baltimore to Coeymans, the boats attacked the gorge proper and cut out a channel from the lower end of the gorge to Corwin & McCulloch's brickyard. The ice was from eight to fifteen feet thick, and when broken up floated away, the current being quite active. As soon as a channel was opened, acres of ice would come up from the bottom. In working at this gorge, it was found that while the ice exposed to the atmosphere was somewhat soft, yet the ice below the water was as blue and solid as when it first lodged in the river. The gorge was concave in shape, the pressure being directed toward the center from east to west bearing the ice down to the bottom of the channel at its deepest point; the highest points were nearest the shore. In ramming the gorge in the center the boats not only opened up a passage, but weakened the entire gorge itself. This was noticed from the fact that a small channel was opened up on the east side of the gorge along the dyke and that the water was forcing itself through the gorge, was noticed by the fact that the ice kept breaking off from the south face of the gorge and floating down stream.

On account of lack of funds the work on the gorge was finished Friday night, but not until the gorge was so weakened by the ramming that all danger connected with it had been removed. It was very evident, however, that had there been

sufficient funds there would have been no trouble whatever in the boats clearing away the entire gorge. During the day, on Saturday, the lower end of the gorge which had been loosened by the ramming, showed signs of breaking up by "buckling" in the center and all during the day great pieces of ice many feet thick broke away from the main gorge and swept down the river; disintegration went on all day and through the night. Shortly after midnight the entire gorge began to move, the lower end of it shoving together in the channel opened by the boats and floating down stream, while the pressure of the water behind forced the upper gorges to follow in the wake of the lower one. This gorge, which was formed in the first place by a twelve-foot freshet and reformed by a fourteen-foot freshet, passed out while there was only a seven-foot freshet in the river at Albany.

On Saturday, the work of the steamboats was thoroughly inspected by a representative of the committee, and on Tuesday, March tenth, representatives of the committee and several rivermen went down the river on the tug boat George C. Van Tuyl, Jr., and inspected the entire river front where the gorges had been located.

The committee feels that the money expended along this line was used to excellent advantage; that the gorge was weakened and caused to go out by the work done upon it at the south side. As a result of this experiment the committee feel confident that steamboats might be used to excellent advantage when the ice in the Hudson river breaks up for the purpose of preventing ice gorges from forming, and that under certain conditions, ice gorges might be loosened by the use of steamboats as was shown in this instance.

The committee have been in receipt of several letters, as well as verbal communications, from a large number of rivermen and others who have watched this work, complimenting them on the success of their effort as well as impressing the committee with the fact that the gorge went out as it did, was due to the work done upon it by the steamers.

APPENDIX No. 4.

Supplemental Matter from Fourth Division.

The local committee reports from this division will be found in connection with the report of the two State Commissioners assigned to the division, extending from page 156 to page 198 of the report of the fourth division.

APPENDIX

No. 5

Bibliography of Flood Literature

Index of Titles Relating to Floods and Torrents, Stream Regulation, Water Storage, Etc.

Bibliography of Flood Literature.

INDEX OF TITLES RELATING TO FLOODS AND TORRENTS, STREAM REGULATION, WATER STORAGE, ETC.

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